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THE STATE MUSEUM AND STATE PROGRESS[1]

It has been the good fortune of the people of this Commonwealth to have elected those men to preside over its interests who were positively instrumental in promoting science and learning, and who were especially active in promoting Agriculture, and the branches allied thereto. Your own recommendations and influence, touching these great interests, are highly appreciated by the people, as is evident from their united movements in establishing institutions which are designed to bear directly upon those objects, and which are specially designed to place them upon a scientific basis. (Ebenezer Emmons to His Excellency Hamilton Fish, Governor, Albany, December 25, 1851.)[2]

THE citizens of New York and their representatives in the legislature are those especially addressed on this historic occasion rather than the distinguished company of scientific men gathered here for this celebration. While the present is a critical period in the moral and economic welfare of our people we predict that the twentieth century, which is still in its youth, is destined to reach its maturity with a far more general distribution of human happiness than the nineteenth. The unequal distribution of the good things of life is the underlying cause of all present social agitation, and by the good things of life we do not mean riches, but family health, food, sunshine, pure air, labor, the beauty of nature, the creative works of man. A redistribution will come about, not through politics which seems to

[1] Address delivered on October 15, 1912, to the citizens and legislature of New York State on the occasion of the opening of the new State Museum at Albany.

[2] "Natural History of New York, Part V. Agriculture," 4to. New York, Boston, Albany, 1851.

produce little except rivalry and bad feeling, nor through socialism which is essentially unnatural, but through the application to human welfare of all of nature's resources, known and still to be discovered. These resources are those of the Creator and therefore administer to our spiritual, intellectual and moral as well as to our bodily welfare. The great pathway to state progress is knowledge, obedience and unselfish utilization of the happiness which nature puts in our hands.

Our theme to-day is the part which the museum has exerted and is destined to exert toward this millennium of the twentieth century.

The rise of the museum as a new force in town, city, state and nation is the latest phase of educational evolution. The school, the college, and the university have gone in advance; the museum follows and is winning its own place and influence because it supplies a demand which none of its sister institutions fills. The very fact of this independent development is a proof that the museum is not one of the luxuries of civilization but an essential and vital force in the enlightenment of the people. Every community, small or large, needs its museum as it needs its schools and its churches. This rise, which is especially remarkable in certain cities of Germany and Austria, throughout England, and above all in the United States during the past quarter century, is largely due to what may be called the new museum idea, namely, that the museum is not a conservative but a progressive educational force, that it has a teaching quality or value peculiar to itself, that the museum succeeds if it teaches, fails partially if it merely amuses or interests people and fails entirely if it simply mystifies. The old museum idea was that of a sanctuary or refuge, a safe deposit vault for curious, rare, or beautiful objects which might be lost or destroyed; the ignorant visitor was tolerated rather than attracted, the curator was a keeper, not a teacher. The new spirit within the natural history museum is the educational spirit, and this is animated by what may be called its ethical sense, its sense of public duty, its realization that the general welfare of the people is the prime reason for its existence, that exploration, research, exhibition and publication should all contribute to this, that to serve a community the museum must reach out to all parts of nature and must master what nature has to show and to teach. The museum will flourish if the high educational service of the state is inscribed over its portals and instilled in the minds of every member of the staff from the highest to the lowest.

What renders this celebration a great one is that the ideal just sketched is largely exemplified in the New York State Museum, in the historic fact that the noble men of science and the wise rulers of our state have long been leaders in one of the great principles of museum development, namely, that the foundation of a state museum is mastery of the natural history of the state itself. In this regard since 1836 New York has been holding the torch for all the other states of the union. There has already evolved here that intimate union between a natural history survey, pure scientific research, a museum and the public welfare which the most enlightened communities in the civilized world have either attained or are striving to attain.

There remains to be developed by the Education Department through the museum the great work of spreading the beneficent products of this union throughout the public educational institutions of the state. This celebration is auspicious because it prepares the way for this new

educational function of connecting the museum with the schools; this commodious building renders it possible for the first time in the history of the institution to expand along all the other lines of the new museum spirit, and directly and by extension touch the entire educational system of the state.

Thus we celebrate not the birth but the opportunity for renewed growth of an institution of which all the citizens of the state should be proud. Like the nautilus the museum moves into a new and beautiful chamber with its fine heritage, its ideals and its purposes unchanged: the shell is not the vital part, but it is highly favorable to the prolonged and expanding existence of the organism within.

In looking for the causes of the origin of this institution we find they are three-fold: first, the natural grandeur and interest of the territory of the state itself as a source of scientific inquiry and inspiration; second, the assemblage of an unusual number of scientific observers of the first order whom New York found among her own sons or attracted to her borders; third, a wise and liberal exercise of the powers of government on the part of the rulers of the state. It follows that our chief concern today should also be three-fold, namely: the preservation of this natural beauty as a continual source of inspiration and happiness to posterity, the birth and training of men and women capable and worthy of observing the laws of nature and spreading knowledge of them, the maintenance of standards of government equal to those of Secretary Dix who first outlined the survey, and of Governors Marcy, Seward, Bouck and Fish who promoted it.

As illustrative of the close union between science and good government two ancient episodes in the state's history may be recalled. One is that Samuel Latham Mitchell, the pioneer of natural science in this state, delivered an evening address before the state legislature, was elected to a seat in the legislature of 1790 and in 1807 took the first steam-propelled voyage up the Hudson with Fulton. Another is that in 1818, on invitation of Governor Clinton, Amos Eaton, the pioneer geologist of the state, delivered a course of lectures before the legislature and interested many of the leading men of the state in geology and its application to agriculture by means of surveys, thus planting the idea which eventuated in the great work, "Natural History of New York."

Is New York state to-day seeking among her votaries of science some of her representatives at Albany to counsel her in matters of state welfare? We may not answer the question but may put another: is the vast free educational system of the state, on which fifty-four millions of dollars are being expended annually, with a total attendance of one and one half million pupils, turning out its due proportion of men of science for the future service of the state? Whatever the answers to these questions, it is certainly well even on a jubilee occasion such as this for the members of a great democratic commonwealth like ours, full of confidence and pride in its institutions, dazzled perhaps by stupendous expenditures and vast numbers of students, to pause and consider which direction our social evolution is taking through education and democracy—progressive or retrogressive.

As regards the birth and education of men of science, the honor roll of geology in this state, the product of old educational methods, is a long one. We are impressed with what the state, the nation and more than this, the world owes to the generation born between 1764 and 1860 within our own state borders. Among the pioneers of

science in this country were the following: Mitchell (1764–1831), born in Hempstead, L. I., whose political services have been alluded to above and who published in 1796 "A Report of the Geology and Mineralogy of the Hudson," the first work of its kind in the United States; Stephen van Rensselaer (1765–1839), born in New York City, founder of the Polytechnic of Troy, patron of the first serious geological work in the state; David Hosack (1769–1835), born in New York City, closely associated with De Witt Clinton in the leadership of civic life, promoter of botany and mineralogy, master of John Torrey; Amos Eaton (1776–1842), born at Chatham, turned toward science by Mitchell and Hosack, whose survey of Albany and Rensselaer counties marked an era in the progress of geology in this country, the master of James Hall; Henry Rowe Schoolcraft (1793–1864), born in Albany county, pioneer explorer of the geology and the mineral wealth beyond the Alleghanies and discoverer of the source of the Mississippi; John Torrey (1796–1873), born in New York City, pupil of Hosack, founder of American botany, master of Asa Gray; Joseph Henry (1799–1878), born in Albany, discoverer of the magneto-electric telegraph, which has put the whole world into communication; William Williams Mather (1804–1859), born in Brooklyn, one of the four geologists of the Survey, pioneer geologist of Ohio and Kentucky; James Dwight Dana (1813–1895), born in Utica, geologist of the Wilkes Exploring Expedition, the foremost geologist of his time in America; Alexander Winchell (1824–1891), born in the Northeast, geologist of Michigan; Othniel Charles Marsh (1831–1899), born in Lockport, famous vertebrate paleontologist, one of the leaders in the exploration of the western states; Robert Parr Whitfield (1828–1910), born in New Hartford, invertebrate paleontologist of distinction; Edward Orton (1829–1899), born in Delaware county, state geologist of Ohio; John Wesley Powell (1824–1902), born in Mount Morris, explorer of the Grand Cañon, famous ethnologist, director of the United States Geological Survey; Israel Cook Russell (1852–1906), born at Garrettsville, geologist, explorer and eminent writer.

We trust space may be found within the new museum, in bust or tablet, to memorialize the services of these great men as well as of those who, like Hall, came from other states. In this matter the state may well follow France, which leads the world in appreciation of its men of science and erects more statues to its savants and litterateurs than to its military leaders.

Among the living natives of the state who have rendered or are rendering distinguished service are Raphael Pumpelly (1837), geologist and explorer; John James Stevenson (1841), geologist of the Wheeler and Pennsylvania Surveys; Grove Karl Gilbert (1843), geologist of two state and two of the national surveys; Charles Doolittle Walcott (1853), leading invertebrate paleontologist and administrator of the United States Geological Survey and of the Smithsonian Institution; last but not least, John Mason Clarke (1857), pupil of James Hall, invertebrate paleontologist, distinguished in geology and paleontology.

From this number the nation has chosen two of the directors of the United States Geological Survey, Powell and Walcott, and two of the secretaries of the Smithsonian Institution, Henry and Walcott.

Our early political governors and men of science found their inspiration in the state itself, in its splendid area equal to that of all New England, in its scenery—including the Palisades, the Hudson, the Catskills, the Adirondacks, the Mohawk,

Niagara, the lake and great western plains district—and in its diversity second only to that of California. Beautiful as the surface is with its flora and fauna, its interest, significance and utility have been vastly enhanced for man by the thorough understanding of its natural history and its prehistory, from the birth of the Adirondacks and Highlands to the final sculpturing of the state by the glaciers, with all the grand procession of life from the time of the interior paleozoic seas to the plants and animals of our day. For all this deeper knowledge we are indebted to the natural history survey of the state, begun in 1836 and practically continuing to the present time.

The Survey[3] was by far the most important scientific event in the history of our state and one of the most important in the history of the nation.[4] It attracted five of the most able geologists and naturalists of the country to its service, Lardner Vanuxem (1792–1848) from Pennsylvania, Ebenezer Emmons (1799–1843) from Massachusetts, from our state Mather, the geologist, and Torrey, the botanist, James Hall (1811–1898) from Massachusetts. The survey set a high standard not only for the state but for the country; it exemplified the ideal development, side by side, of pure and applied science. Emmons observed:

> The Survey of New York was indebted for its projection and execution to a movement in science —a movement which pervaded the entire thinking community. It was one of those natural results which mark the progress of truth; and itself was an evidence of the progressive intelligence of the human mind.

Hall observed:

> The enlightened spirit in which this Survey was directed, and the munificence with which it has been sustained, have afforded every means required for its completion. The state of New York, which has hitherto established her claim to the dignity of the Empire State, has now added another wreath to her laurels, in becoming the first in the patronage of science, and in the benefits thereby bestowed on her citizens, as she is first in resources, in commerce and public improvements.[5]

Mather observed:

> The State of New York is the first that fully carried out the principle of division of labor in the execution of a survey on the Natural History of the State, under the name of a geological survey. By this arrangement each head of a department of the survey has been enabled to devote his whole time and attention to his own specific duties, without having the entire range of natural science to distract his attention. . . . The survey of New York, unlike that of some of the other states, has been uninfluenced by party and political considerations, and the chief magistrates, during its execution, have been actuated by high and ennobling motives.[6]

Merrill observes:

> This led to an organization which has left a more lasting impression upon American geology than any that has followed or had preceded it. As fate ordained, the locality was one of the most favorable that could have been selected for working out the fundamental principles of stratigraphic geology; moreover, those appointed to do the work proved equal to the occasion. The New York survey gave to American geology a nomenclature largely its own; it demonstrated above everything else the value of fossils for purposes of correlation, and incidentally it brought into prominence one man, James Hall, who was destined to become America's greatest paleontologist.[7]

[3] It was the essay of John A. Dix as Secretary of State (1835) on the Natural Resources of the State that was the efficient final act before legislation was effected, a report prepared at the request of the legislature with reference to the organization of the Natural History Survey.

[4] See Merrill's "Contributions to the History of American Geology," p. 344.

[5] Hall, James, "Natural History of New York," Part IV., 4to, New York, Boston, Albany, 1843, p. ix.

[6] Mather, Wm. M., "Natural History of New York," Pt. IV., 4to, New York, Boston, Albany, 1843, p. x.

[7] Merrill, George P., "Contributions to the History of American Geology." Rept. U. S. National Mus. for 1904, pp. 189–734 (p. 344).

What was discovered by the original Survey fills thirty great volumes, stately and beautiful in form, epoch-making in content. The data in these works and the new series of thirteen "Memoirs of the State Museum," published between 1889 and 1910, are the units out of which, together with our present knowledge, the wonderful geologic history of the state with all its natural mineral wealth and other resources, its botany and zoology, can be written.

An outline of this history may serve the practical man as a brilliant instance of the union between pure and applied science, between theory and practice, but more than this it may show the lover of nature the new fascination and glamor which a knowledge of the past lends to the present.

Geology has shown that there are in New York state two great mountain uplifts or granitic sentinels surviving from the very beginning which are still centers of greatest beauty: to the north, as an outpost of the Canadian nucleus of the North American continent, lies the rugged mass of the Adirondacks, to be imagined as an island of ancient crystalline rocks, which has been above the ocean since the geologic dawn, its ancient mountains now worn down to their roots by erosion in succeeding ages and still flanked around the base by the old shore formations of the Cambrian and later periods. To the south lie the equally ancient Hudson Highlands and the rugged ridges of Westchester county, stretching southwestward from New England, the vestige of an eastern land mass of early geologic times which is now in large part sunk beneath the waters of the ocean or covered by more recent formations, the débris of struggles with the encroaching Atlantic. In this old pre-Cambrian continent, whose crystalline schists have been the special study of Kemp, are found our building granites, our magnetic iron, our rich deposits of talc and soapstone, sources of industry and welfare.

There were also two historic seas: the interior sea, or American Mediterranean, which bounded these granitic sentinels on the west, and the ancient Atlantic, which bounded them on the east. Our Atlantic coast line during the Paleozoic Period stretched far to the east, perhaps as far as the continental shelf, one hundred miles east of Long Island, where the depth then, as now, rapidly increased to the abyssal ocean.

There were also two great inclines or drainage systems, the first emptying into the interior sea which stretched from the south and west over a large part of the continent. During these early epochs central and western New York formed a battle ground between this inland sea and the granitic lands to the north and east; the shore lines advanced and receded, spreading the gravel beds and sands or the silt and calcareous ooze of the deeper waters in alternating succession over the broad plains of central and western New York. To the receptive basins of these shore lines of Silurian and Devonian age our builders largely owe their sandstones and limestones, their limes and cements. To the plant life imbedded in Silurian and Devonian times we owe our natural gas and our petroleum. Of Silurian age are our hematite iron ores. Great coastal evaporating basins of Silurian times have bequeathed to us our gypsum and our salt.

In the prolonged struggle the forces of uplift were finally victorious; the inland sea retreated step by step to the south and west until in the era of the great coal forest of Carboniferous times, the border line of permanent land has passed beyond the limits of what is now the state of New York. This is the reason the state has no

coal. Throughout the central and western portion the rock formations still lie relatively flat and undisturbed; from the line of the Mohawk valley and the southern shore of Lake Ontario the successive strata rise tier above tier until they culminate in the Catskills to the east and the Pennsylvania border.

In 1836 James Hall was assigned this level and supposedly uninteresting portion of the state, the fourth district, which he was told "was good enough for a young man of twenty-five." The region was regarded as of little promise and was willingly relinquished to him, and this proved to be one of the happy accidents of geology, for Hall's genius revealed the fact that nowhere in the world does there exist so complete a series of the older fossiliferous rocks, such continuous records of the life of the ancient inland sea; in wonderful perfection the animals that lived in the shallow waters and along our inland coast have yielded the data for the paleontologic researches of the master and his pupils Merrill, Whitfield, Clarke, and others.

The second great drainage system, now represented by the vestigial Hudson river, is that which flowed from northwest and southeast between the northern and southern granitic masses of the Adirondacks and the Hudson. This broad trough, or valley, was developed east of the Appalachian uplift and included the Shawangunk[8] mountains. In it were accumulated the sediments washed down from the adjoining mountains during Triassic and early Jurassic times, to form the red sandstones and shales of the "Newark System," extending across the New Jersey border into Rockland county, and recently yielding at Fort Lee one saurian of Triassic age. The great red sandstone delta was in turn tilted and heavily faulted, and along the fault lines and between the strata of shale and sandstone welled up the great outpourings of basaltic lava which formed the trap rocks of the Palisades and parallel ridges to the westward.

Toward the close of the Age of Reptiles the littoral strip began subsiding beneath the Atlantic ocean, converting the shore line into a coastal swamp over Long Island; but the greatest factor in Long Island's history was the Glacial Epoch at the close of the Age of Mammals, when the ice cap extended downward from eastern Canada over almost the whole of New York state and left as its terminal moraine the long, irregular line of hills of boulder, clay and sand stretching along the northern shore of Long Island across Staten Island, New Jersey, Pennsylvania, and westward. To this we owe our building clays. This great ice sheet, as studied by Fairchild, Woodworth, and others, gave the final touch to our landscape and to our agricultural lands, gouging out valleys, blocking rivers, piling heaps of detritus across valleys during its slow retreat to the north, profoundly modifying the topography of the state, shaping the basins of many of our lakes, the courses of our rivers, and the character of our soil. At the beginning of the ice retreat the cap so blocked the St. Lawrence river valley that Lake Ontario found its outlet along the Mohawk river into the Hudson. All the life records of the

[8] The Shawangunk Mountains belong to the Appalachian uplift which succeeded the Carboniferous, hence very much more ancient than the later disturbances of the Highlands. The Catskill uplift belongs to the same age of general elevation as the close of the Carboniferous. It escaped the general reduction of the rest of the Alleghany Plateau for reasons not at present evident except in the hard nature of its rocks. The Hudson Highlands region has gone through its oscillations quite completely since the origin of the mountains referred to. The Highlands have gone far down after having been raised high, and are now apparently on their way up again. This statement relates to the relation of the Highlands to the cutting down of the Hudson River. (J. M. C.)

later geologic periods in New York state were swept away by erosion or buried beneath the débris of the Ice Age. Only from the swamps and peat bogs formed since the retreat of the ice have been disinterred the skeletons of mastodons[9] and other extinct forms.

Science, like charity, begins at home. Our Education Department could not do a wiser thing than to popularize the technical geology of the state in a school book and put such a volume into the hands of every scholar; it would exert a vast influence.

The animal and plant life of the state formed the second great branch of the Survey. As a result New York state has taken a leading part in the encouragement and development of the study of birds in this country, from 1844, when the state issued a quarto volume of 380 pages and 141 colored plates by James E. De Kay, "On the Birds of New York," to 1910, when it published the first of two superb quartos by Eaton with colored plates by Fuertes; and here again the Survey has been more or less directly the means of bringing out the latent ability of sons of the state. Among the ornithologists, all natives of New York, who have been developed during this period, are Giraud, Mearns, whose researches have extended all over the union and to Africa, Merriam, head of the U. S. Biological Survey, and our leading field naturalists, Bicknell, Ralph, Bagg and many others.[10]

The Survey also produced in 1842 De Kay's four volumes devoted to the mammals, reptiles, and amphibians, also the extinct mammals of the state as they were known in 1842. Later contributions to the mammalian life independent of the survey were Merriam's "Mammals of the Adirondacks," 1882 and 1884, Miller's "Preliminary List of the Mammals of New York" in 1889, and Mearns's "Mammals of the Hudson Highlands" and "Mammals of the Catskill Mountains."

The practical results growing out of the State Survey are no less significant than the theoretical, affording the strongest proofs that discovering and spreading knowledge of nature is the best investment a state can make, because all wealth and all health flow from such knowledge. When state funds are used for the forces which make for production the payment of interest is retarded, perhaps beyond the lifetime of the individual who makes the discovery and when returns do come the discoverer is often forgotten; only in rare instances does he benefit from them. The chief applications of the results of research have been to agriculture and mining; in fact, the science of agriculture was one of the original motives in the organization of the Survey, and the four volumes which Ebenezer Emmons devoted to the agriculture of New York and to its fruit culture between 1846 and 1854 led to the organization of the State Agricultural Society and finally to the State Agricultural Department.

The increase in the value of the mineral product[11] of the state since the organization

[9] Mastodons and mammoth remains are found in swamps and beaches of the same age, though the occurrence of the latter is comparatively rare; they are contemporaneous, but it is probable that the mastodons survived the mammoths within our area. (J. M. C.)

[10] C. Hart Merriam, New York City, 1855; Edgar A. Mearns, Highlands Falls, 1856; E. H. Eaton, Springville, 1866; E. P. Bicknell, Woodmere, L. I.

[11] Mineral productions of the state—

	1837	1911
Iron ores from within the state	1,000,000	3,184,054
Clay materials	150,000	9,734,744
Building stones	500,000	5,520,800
Salt	625,000	2,191,485
Gypsum	15,000	1,092,598
Cement	150,000	3,065,334
Materials not produced in 1837		6,784,093

of the Survey has been approximately 3,000 per cent. The fact speaks for itself without claiming for the geological organization all the credit for this tremendous development. The approximate output of minerals of all kinds for the year 1837, the first year in which the Survey did actual work, was two and one half millions; the total mineral production for the year 1911 for materials within the state was thirty-one and a half millions; but including the ores brought in from outside the production is seventy-four and one half millions, ranking New York state as the sixth state of the union in the value of its total output. The preeminence of Pennsylvania, Illinois, Alabama, and West Virginia is due to their coal, that of California to its oil. As a result of the careful surveys made within the last few years the volumetric totals of the iron ores still available for commerce are shown to reach nearly one billion tons, interesting as indices of the potential natural wealth of a state which has no coal and comparatively little oil. The scientific foundation of this development is the volume "Mineralogy of New York," by Lewis C. Beck, published in 1842.

The most recent instance of the interrelations between pure science and progress is that developed by the need of the City of New York for an increased water supply, involving the second greatest engineering task of modern times. When work on the new aqueduct was actively undertaken ten years ago, the chief engineer, J. Waldo Smith, one of the broadest minded men of his profession, realized that the geological structure and the present and past history of the region to be traversed entered in a fundamental way into the problem. The region embraces the Triassic and Archean formations of the state from the Upper Devonian downward, formations to which the survey has devoted pure research since 1836, formations folded, faulted, and metamorphosed in a most complicated manner. The surface features are concealed everywhere with drift of the Glacial Epoch, which at places like a thick mantle covers buried channels or pre-glacial systems of drainage which cut the bed rock to depths much below the present level. At the Storm King crossing of the Hudson the rock bottom is 800 feet or more below the surface of the river. With their thorough understanding of these facts, the consulting geologists Kemp, Crosby and Berkey aided the engineers in selecting the best locations and in forecasting the underground geology for the preparation of specifications for the contractors. Conversely the great tunnels and sections of the engineer have laid bare new matters of great value to the geologist; matters of inference have become the recorded facts of observation; estimates have given way to precise measurement in feet and inches. All this experience, embracing so much of human, scientific, and technical value, is to be brought together in a volume by Berkey and published with abundant profiles and illustrations in a bulletin of the State Museum.

The scientific growth of New York state is the past, the present, and a forecast of the future of our State Museum. The offspring has become the parent; the museum now conducts the geological and other surveys of the state. From its slow birth under the Natural History Survey between 1836 and 1843, under vicissitudes of name, of scope, of direction, and of dwelling place, the State Museum is now the titular head of the survey and of the entire science division under the New York State Education Department. The paleontologic, geologic, mineralogic, and botanic departments, independent offshoots of the survey, were brought under the regents of the uni-

versity in 1883, and in 1889 the museum was made an integral part of the University of the State of New York. A further concentration took place in 1894 when the university was fused with the New York State Education Department, under which a division of science was created. This division was charged with the broad powers of administration of the museum and with the geology, paleontology, botany, entomology, zoology, and archeology; in brief, it is the scientific scope of the old Natural History Survey of 1836 with the added custodianship of all the materials brought in. As compared with our central government, it is the United States Geological Survey, a part of the Agricultural Department and the National Museum swept into one under a bureau of education. Such unification is, so far as we know, unique; it is certainly logical in the sense that all state-supported scientific work should be *educational* in the very broadest sense as well as in the interests of pure research; as an administrative system it is an experiment which is well worth trying by our state, for it may be of value in Washington, where concentration of all the scientific bureaus of the government has long been under consideration.

Under the directors Hall, Smock, and Merrill in the years that have passed since 1904, the date of the appointment of John Mason Clarke as head of the museum and of the survey, the historic lines of geology and paleontology have been ably sustained, lines which are among the most honored traditions of the institution, together with greater activity along lines which had not been especially developed in its previous history. Thus while the study of plant and insect life has followed the earlier lines of economic service to the state, there has been continued advance in the study of mammal and bird life, of the past and present life of the Indian. Every effort is being made to represent in full in the museum the fauna of this state and to exhibit it as effectively as practicable. In archeology the unique field is the study and portrayal of the culture of the Iroquois, which brings the museum in touch with the 6,000 Indians of the state, their history, ambitions, and ideals, and it is fortunate that the preservation of the traditions and the folklore of this declining race is entrusted to the State Museum. Following up the work of Lewis H. Morgan, who probably contributed more to initiating and advancing anthropological work among the Indians of the state than any other person, there were the writings of Beauchamp and the studies of Converse, while among the younger contributors may be mentioned Parker, the present state archeologist, and Skinner.[12]

The law also provides that the State Museum shall cover the field of history, and the initiation of this problem is large because it has hitherto been entirely neglected by the state and important because of its educational bearings.

The original function of the museum as a depository of all the scientific materials brought in by the survey should be extended along lines similar to those followed by the National Museum of Washington, so that the new Conservation Commission with its interests in the forests, the fisheries, and the game of the state shall find the rooms of the State Museum equipped for the scientific materials which come to the commission. Similarly the department of the state engineer, the departments of agriculture, of health, and highways, should regard the halls of the museum as the place where the people are to find the visible educational materials developed with the growth of these several departments. This cooperation is in keeping with the unifica-

[12] Harriet Maxwell Converse, Arthur C. Parker, Alanson Skinner.

tion of the advance of pure and applied science in the progress of the state.

We may well ask what are the distinctive features of an ideal state museum as contrasted with great civic museums like the American Museum of Natural History of New York, the Field Museum of Natural History of Chicago, the Carnegie Museum of Pittsburgh, or a great national museum like that in Washington? Why should a state have its own museum, apart from the historical and political reasons which have located this institution at Albany? The answer is largely given in the preceding portions of this address. The museum is the natural scientific center of the state government; it is the natural depository of all the material brought together by the state surveys, it is the natural custodian of all purely scientific state records; it is the natural center of the study of the resources of the state as a political unit; it must maintain its capacity for productiveness in pure scientific research—pure science has been the justification of the state museum from the beginning of its history. For example, it is justified in issuing a monograph on the birds of New York state, as it is now doing, because this kind of publication belongs to the museum historically, because the education of the people of the state in the important matter of the economic value of bird life must be accompanied by the preservation and exhibition of the materials on which the volume is based. In brief, the distinctive sphere and scope of the state museum corresponds with the scientific interests and welfare of the people within the geographic boundaries of the state.

Yet in no relation is the function of the state museum more full of promise than in its relation to state education, a relation which it already maintains but which should be greatly extended in the future. The peculiar teaching quality of a museum is that it teaches in the way nature teaches, by speaking to the mind direct and not through the medium of another mind. This principle of natural instruction is being carried out in the development of the exhibits of the museum, and through photography these exhibitions may well be extended to the schools of the state. The museum should be the center from which the visual and practical instruction of the children of the state in science should emanate. The pulse of the new museum should be felt in every country school in the state and in the schools of every one of its cities which has not developed its own museum center. The museum should supply the schools with collections of scientific materials; it should distribute traveling demonstrative collections in natural history. In brief, it should supply the State Education Department with all materials for the visual instruction in the scientific features of the state for distribution among the schools. Our school children should receive their first inspiration in science not from abroad but from the things about them. There is every reason why the state museum should do for the resources of the state what the Commercial Museum of Philadelphia is doing for the people of Pennsylvania.

The execution of these ideals requires a combination of scientific and administrative ability with a strong sense of public duty, which I dwelt upon in the opening paragraphs of this address. Our great commonwealth is to be congratulated on having at the head of its educational system a man of the breadth of view of Dr. Andrew S. Draper, and at the head of this institution a man of such thorough preparation, wide sympathies and executive ability as its present director. In assuming the centralized control both of the Geolog-

ical Survey and the State Museum in 1904 Dr. John Mason Clarke inherited positions rich in traditions and undertook no light task. Long years of experience as an assistant to James Hall had given him a wide and thorough knowledge of the state's geology and paleontology, and, quite as important, of its legislators. Although a paleontologist and stratigrapher himself, all the other lines centering in his office have received his support. While the great monographs on the faunas of the Devonian, the graptolites, the ancient sponges and the eurypterids have seen the light, the areal geology has had its full recognition, the ancient crystallines have received no less attention than the fossiliferous beds and the mineral resources. Botany, zoology and archeology have had their due and are well represented in the publications of the state museum. The geologic map of the state has progressed on the topographic scale of one mile to the inch, so far that almost one half of the area of the state has been plotted in minute detail. The museum has kept in touch with and published the geological results obtained in connection with the development of the aqueduct. It has availed itself of the cooperation of many of the most able specialists in the state.

It is now the great opportunity of our state not only to maintain liberally a museum the purpose of which is to present in fulness the character of its natural resources, but to furnish the State Department of Education with the means of spreading the work of the museum in popularized form throughout the schools of the state. The appropriations have doubled in recent years, now amounting approximately to $40,000, but they are insufficient to develop a museum worthy of the dignity of the state of New York either along the lines of exhibition or those of public education.

The truest measure of civilization and of intelligence in the government of a state is the support of its institutions of science, for the science of our time in its truest sense is not the opinions or prejudices, the strength or weakness of its votaries, it is the sum of our knowledge of nature with its infinite applications to state welfare, to state progress and to the distribution of human happiness.

Henry Fairfield Osborn
American Museum of Natural History

ADDRESS OF PRESIDENT TAFT AT THE FIFTEENTH INTERNATIONAL CONGRESS ON HYGIENE AND DEMOGRAPHY[1]

It is my pleasant and honorable duty, on behalf of the people and the government of the United States, to welcome this great congress to Washington.

"Prevention is better than cure." The science of medicine and surgery has made wonderful growths in the last forty years, but in that time it would seem as if the science of sanitation, of hygiene and of preventive medicine had come into being from nothing. And now the two, prevention and cure, through the intense energy, industry, application, keen discrimination and high and enthusiastic aims of the benefactors of human kind, who are now devoting their lives to research, and the investigation of the cause of disease, its transmission and its antidotes, are proceeding, *pari passu,* with such rapidity and success that in the next century we may almost expect to find the equivalent of that fountain of youth and perpetual life which was sought for in this country by some of the early discoverers.

It is easy to make an error with reference to the beginning of a great forward movement by dating it from the time when the

[1] Official report of the address given at Continental Memorial Hall, Washington, D. C., September 23, 1912.

would-be historian has become alive to its progress and convinced of its importance. Now, I do not mean to say that our sanitary science in this country began with the Spanish war; I do not mean to say that it had its origin in the tropics; for I have no doubt that nearly every one who hears me could confute such statements, by reference, for example, to the robbing of dread diphtheria of its terrors by antitoxin and other similar revolutionary discoveries. And yet it is true that out of a war, very short of duration, and of comparatively little importance in the number of men engaged, and the cost, and the lives lost, there came to this country a series of problems, the most important of which included questions of sanitation, the methods of transmission and the cure of tropical diseases, the adoption and enforcement of a system of hygienic law, and the establishment in the tropics of governmental institutions of medical research by army, navy and civilian physicians, which have brought to the attention of the whole country the necessity for widespread reform in our provisions for the maintenance of health and the prevention of disease at home.

Our responsibilities in Cuba, Porto Rico and the Philippines, and now on the Isthmus of Panama, have so enlarged our knowledge of the possibilities of successful sanitation under the most burdensome conditions, and have so impressed both professional men and the laymen at all familiar with conditions, with the necessity for more rigid and comprehensive health laws, and a stricter enforcement of them for the general public good, that if the Spanish war resulted in nothing else, it was worth greatly more than it cost, in this useful development of one of the most important functions that modern government has to discharge, as well as in making clear the need of an additional branch of general education in the matter of the hygiene of the home and of the individual.

It would seem as if the tropics were the proper place for the beginning of a crusade on this subject. In the tropics nature has a more rapid growth, not only in vegetation and in animal life, but the diseases are shown on a larger scale and permit the study of their development with more certainty of conclusion than in the temperate zone. The effect of preventive regulation upon great bodies of persons is more clearly marked, and the reward for hygienic strictness seems greater and more obvious. When we first went into the tropics, our purpose was to make that region habitable for white people. We have demonstrated that as a possibility. Now we have gone beyond the provision for those who come from the temperate zone, and we are engaged in the work of developing the tropical races into a strength of body and freedom from disease that they have never had before. The prevalence in a whole race of the hookworm, or of malaria, or of beri-beri, the persistence in the intestines of an entire population of many varieties of disease germs which do not destroy, but weaken and stunt and shorten life, shows the possibility by proper health methods and proper treatment of revitalizing tropical races and securing from them that vigor of physical action which will enable them to develop and enjoy the marvelous richness of the countries in which they live. Of course the problem of enforcing health regulations against the will of an ignorant people, whose natural laziness and resentment at discipline makes the enforcement most difficult, requires a strong government and the raising of a sufficient fund by taxation to maintain an adequate health police. These are the problems in the tropics that every government that has dependencies must meet. There is no difficulty about running a government cheaply if you limit its functions to the mere matter of the preservation of peace and the administration of justice; but if you propose to add to these adequate systems of education, government hygiene, good roads, and other internal improvements, then you must look about for sources of revenue which are not always forthcoming, and an absence of which retards the progress that every good administrator longs for in the interest of the people entrusted to his charge. And then if the government to be established is to be more or less popular, the

people themselves must be educated to understand the importance of the hygienic restrictions, to accept them, and themselves to impose upon themselves the burden of taxation which it is essential for them to carry in order that any progress shall be made at all.

I consider it a proud record of the American army that through its medical corps engaged in hygienic work, so many important discoveries as to the transmission of disease and the method of stopping its spread, have been given or proven to the world, and all of this is dated chiefly from the time of the Spanish war. The elimination of black smallpox by thorough vaccination, the study of bubonic plague, its mode of transmission, suppression of its causes and its methods of treatment, the study of cholera and its method of treatment, together with the preventive inoculation, the study of beri-beri, and the methods of its prevention and cure which have not, even as yet, been altogether satisfactory, the learning of the causes of yellow fever by transmission through the mosquito and its method of treatment so as by isolation of both the patient and the mosquito to prevent its spread in a community, and its ultimate suppression, the minimizing of the bad effects of malaria by the destruction of the mosquito which carries its poison, the ridding a race of the hookworm and its demoralizing physical degeneration, the prevention of typhoid by inoculation, all constitute great steps forward in the treatment of diseases that though most of them are especially formidable in the tropics, are general also in the temperate zone, and in these discoveries which have been made, it is most satisfactory to be able to say that our American physicians have taken and are taking a most important and honorable part. It is very certain that but for these discoveries the construction of the Panama canal, which now since 1904 has been going on with giant strides, and which will be completed within a year, would have been impossible. The effort of the French to build a much smaller canal at the same place would doubtless have been successful but for the problems of hygiene which the science of that day did not enable them to solve. And now it is proper that the chief health officer in charge of that strip forty miles long by ten miles wide, who has enabled 50,000 people to live there in health and build the canal, should share with the chief engineer the honors when the end shall crown the work. It was most fortunate in working out the problems that these agents of health on the Isthmus had no limitation put upon them with respect to expense, and that everything was at their hand to accomplish the purpose of the nation. Other problems which shall arise in the future may not be so fortunately circumstanced, and economy and the limitations of expense may call attention to the necessity for finding changes in method which shall reduce the cost of the work and bring it within reasonable figures, but it is well that the first effort was not hampered by such considerations. Of course, while the great problem was the problem of the maintenance of the healthfulness of the Isthmus during the construction of the canal, there still remains the important one of keeping the strip healthful while the canal is operated.

The possibilities of improvement through governmental hygiene of tropical countries are so great that it makes one who has any conception of what they are grow enthusiastic in the contemplation of what centuries may bring forth in this regard. Of course, one of the things that will have to be brought about is effective and efficient government in the tropics, and how this is to be reconciled with the growing tendency toward more and more popular government is a question of the education of the people in governmental responsibility. Still the amount which can be done in the enforcement of principles of hygiene with the tropical races and with those who live in the tropics, has already had sufficient demonstration to make one with any imagination at all anxious to look forward to the development of the world around its middle after the temperate zone shall have been occupied to such an extent as to make the enterprising of their inhabitants look elsewhere for migration and settlement. The mere matter of

the improvement of people in the Philippines by the establishment in each village of artesian wells, so as to give them pure water, gives such a marked decrease in the mortality and such a marked increase in the health of the inhabitants as to show a present condition that is capable of wonderful amendment.

I have dwelt at length upon the tropical hygiene because my responsibilities have brought me more into contact with that than with the hygienic problems of the temperate zone, where improvement in conditions is necessarily less marked, because the conditions are not so deplorable when attacked. The range covered by the considerations of this congress is so wide as to be almost bewildering, and the problems which are presented in working out the improvements toward the ideals that are presented are of course most various and most complicated. The question of the interference with personal liberty through the insistence upon the enforcement of health regulations does not present itself in the temperate zone so often as in the tropics, because the prevalence of infectious and contagious diseases in the form of an epidemic is not so great; and yet, as we go on to regulate how people shall live, we may expect to find, as indeed we have already found, considerable resistance and inertia that requires care and caution in the drafting of drastic regulatory provisions. Then the expense of the maintenance of a force sufficient to carry out useful regulations is a most serious question in carrying on a proper government. The number of things that the government has to do has increased so rapidly under the modern view that the necessity for economy in administration was never greater, while the burden of taxation continues and must continue to increase.

I do not doubt that we are beginning a new epoch in humanity's history in this country in reforms looking to the bodily health of those less fortunately circumstanced in their life's condition and work. The study of vital statistics showing the prevalence of diseases and tracing their causes must prompt the organized effort of governmental forces to minimize the causes, and to furnish remedies for the evil. We have already begun the reform, in our pure food law, in our mining bureau and our children's bureau.

We must initiate investigations into diseases of particular occupations with a view to regulation or prohibition. An example of this we have in the heavy tax upon the making of white sulphur matches. Still greater opportunties for improvement are before us. We need to develop under governmental auspices a bureau or a department, in which the funds of the government shall be expended for research of every kind useful in the practise and enforcement of hygiene and preventive medicine. That something of this sort may grow out of the present United States Public Health Service there is reason to believe, but it will need far greater appropriations and a widening of its scope of duties before it shall have filled the place that the medical profession of this country has a right to expect the general government to create in the progress of hygiene and demography.

I have said little or nothing about the vital statistics, not because I would minimize its importance, but because my information in respect to it is so faulty. I am very certain that we are far behind other countries in the completeness of our vital records, because we are a new country, and we have not stopped to make the needed registers of lives and deaths and diseases and in the hurry of our existence we have failed to appreciate the enormous value that attaches to such statistics in the study of improving methods and the ascertainment of facts essential in the development of hygienic science.

I can not conceive any congress of a more useful character than the one which it is now my honor to welcome. It is useful, first, because a comparison of the ideas and the discoveries and the theories of men engaged in the same hunt for truth, and in the same delving into the mysteries of nature, with a view to wresting her secrets in the matter of the cause and cure of disease, must result in a general benefit to all who take part in such a congress. The science of hygiene and sanita-

tion and demography must be given an impetus the world over by the temporary concentration in close quarters of men from all the world who have been giving their life work to the same problems. It is delightful to contemplate this phase of the congress, because it is one of those shining instances of worldwide organization for the promotion of the peaceful arts, of which I am glad to say the number is growing every year, and in which the common interest of humanity is made conspicuous by contrast with the selfishness and isolation of each nation in the conflict of interests that are typified by our burdensome and ever-increasing preparations for war. Such congresses can not but make for the permanence of peace. They must create a deeper love of man for man. They do stir up in the membership of such a congress, having representation from all the world, a greater human sympathy, and offer to the scientific student who is willing to devote his life to the development of a truth that shall add to the health and comfort and happiness of his fellows, a reward that can not be measured in money but is to be found only in the consciousness of the highest duty well done. But while these things are true with respect to the world effect of such a congress, its local influence upon a country like the United States is much more marked and important in the impetus that it gives to all who are responsible for the health of the community either in their profession or by reason of their official and governmental responsibility. They must have in such a meeting as this, their ideas and their knowledge enlarged, and they must derive an inspiration for better and more enthusiastic work from the commingling of the greatest scientists of the world here, and their exchange of views, and from the very energizing atmosphere of the congregation. I should think that such a congress as this would increase the number of novitiates for the profession of medicine and surgery. Within the last fifty years, no profession has shown such progress, no profession has come near it in the development of its importance for the promotion of the health and comfort of mankind; no profession has offered to its devotees, in such measure, the priceless reward that comes to any one who has wrested from nature one of her secrets and by disclosing it to his fellowmen has furnished a means for their happier lives.

I congratulate the medical profession of the United States upon this great congress, whose coming here is due largely to their initiative, and the membership of which in large part represents the medical science of the world.

Ladies and gentlemen of the Fifteenth International Congress on Hygiene and Demography, I welcome you to America. I welcome you to Washington. I sincerely hope that your stay here may be as pleasant and agreeable as I am sure it will be useful to this country and to the world.

TWELFTH ANNUAL INTERCOLLEGIATE EXCURSION OF NEW ENGLAND

The twelfth Intercollegiate Excursion will be held in the vicinity of Meriden, Connecticut, under the direction of Professor W. N. Rice, of Wesleyan University.

Members of the party are invited to visit the geological and mineralogical collections of Wesleyan University, in Middletown, on the afternoon of Friday, October 18. At 6:30 P.M. a collation will be served in Fisk Hall, Wesleyan University. At 7:30 P.M. a meeting will be held in the lecture room of the Scott Physical Laboratory. A lecture illustrated with lantern slides will be given by Professor Joseph Barrell, of Yale University, on "Central Connecticut in the Geologic Past." After the meeting, the party will go by trolley to Meriden, and spend the night at the Winthrop Hotel. The price of lodging at the Winthrop Hotel for members of the party will be one dollar. Breakfast à la carte.

At 9:00 Saturday morning, October 19, the party will take a special car for Westfield. The trolley line follows in general the line of the great fault between Higby Mountain and Lamentation Mountain. The return from Westfield to Meriden will be made partly on foot, and partly by the special car which will be waiting at various points along the route.

Attention will be called to the drag dips and other evidences by which the line of the fault can be traced. The topographic effect of the fault can be seen very satisfactorily from the south peak of Lamentation, which will be ascended. The party will visit the site of the once picturesque Westfield Fall, and its little post-Glacial gorge. In a railroad cut near Westfield three small faults marked by drag dips can be observed. In the same vicinity can be seen evidence that the posterior trap sheet, at least in that vicinity, is a double sheet. Lunch will be taken at the club house at Highland. Price, seventy-five cents. Party will arrive at Meriden at 5:13 P.M.

The route is on the Middletown and Meriden sheets of the Topographic Map of Connecticut. Reference may be made to Davis's paper on the "Triassic Formation of Connecticut," in the 18th Annual Report of the U. S. Geological Survey, and to Rice and Gregory's "Manual of the Geology of Connecticut," Bulletin 6 of the Connecticut Geological and Natural History Survey.

Meriden is on the N. Y., N. H. and H. R. R., between Hartford and New Haven. Middletown can be reached from Hartford or New Haven *via* Berlin, from Hartford by the Valley Branch or by trolley, from New Haven by the Air Line, from Meriden by trolley.

Every one is earnestly requested to inform Professor Rice as early as practicable, whether he will be present at the lunch in Fisk Hall Friday evening, and whether he wishes to engage lodging at the Winthrop Hotel, as well as whether he will be in the party on Saturday.

HERDMAN F. CLELAND,
Secretary

WILLIAMSTOWN, MASS.,
October 5, 1912

THE STUDY OF MALARIA

THE first expedition from the Tulane University School of Tropical Medicine to the tropics for the study of malaria was made possible through the kindness of an unknown friend of the school who, through Dr. Isadore Dyer, dean of the medical department of Tulane University, contributed a fund to finance the project.

The United Fruit Company, who have already contributed $25,000 towards the expenses of the School of Tropical Medicine, placed their steamships and other equipment at the service of the school for the transportation gratis of the expedition and apparatus. Colonel W. C. Gorgas, chief sanitary officer of the Panama Canal Zone, with various members of his staff, placed all the material in his hospitals at the disposal of the expedition and extended every possible courtesy.

The personnel of the expedition consisted of two members of the school, Dr. Charles Cassedy Bass, assistant professor of tropical medicine and hygiene, and Dr. Foster Mathew Johns, assistant in the laboratories of tropical medicine and hygiene.

The object of the investigation was the cultivation of the malarial parasites *in vitro* which had already been accomplished by Professor Bass, but many details of which remained to be elucidated and confirmed.

In this the party obtained complete success. It was found that the malarial plasmodia can be grown in human serum, in Locke's fluid (from which calcium chloride is omitted) and in human ascitic fluid. In the majority of the cases dextrose must be added to the medium to secure satisfactory growth. The most favorable temperature for the cultivation of plasmodia is about 40° C.

Positive cultures were obtained from 29 cases of æstivo-autumnal malaria, 6 cases of tertian and 1 case of quartan. Cultures were carried on for four generations from the parent culture before the expedition left Central America, and can probably be maintained indefinitely.

The full report of the expedition may be found in the October number of the *Journal of Experimental Medicine.*

In addition to these researches the school has also carried out experimental work on pellagra, leprosy, beri-beri, blackwater fever, filariasis and other tropical diseases, which work will be found in the forthcoming first report of the school.

The school is under the direction of Dr. Creighton Wellman, formerly of West Africa and the London School of Tropical Medicine.

It is an integral part of the medical department of Tulane University of Louisiana, and begins its second year of existence with bright prospects.

THE ESKIMOS OF CORONATION GULF

The Stefansson-Anderson expedition to Arctic America was organized in 1908 and sent out under the auspices of the American Museum of Natural History. The expedition was in charge of Mr. Vilhjalmr Stefansson, a graduate of Harvard University, and Dr. R. M. Anderson, of the University of Iowa. Mr. Stefansson devoted his attention to the anthropological work of the expedition, while Dr. Anderson was occupied with the zoological work.

Between May 13, 1910, when he first came in contact with the Eskimo of Cape Bexley, and May 18, 1911, when he left the Prince Albert Sound people to return to his base near Cape Parry, Mr. Stefansson saw about a thousand persons, roughly speaking. He took cephalic measurements of 206 of these.

It appeared both to Mr. Stefansson himself and to the Alaskan and Mackenzie River Eskimo who accompanied him on this journey that the people visited differed considerably in physical characteristics from any Eskimo they had seen previously. Perhaps the most striking feature was that beards were not only more common and more abundant than among the men of the western Eskimo, but also of colors varying from black to a very light brown tending to red.

The blond tendencies are most prominent in southwestern Victoria Island, but they are met with at least as far east as a hundred miles east of the mouth of the Coppermine River, Coronation Gulf. Although no scientific census was taken to determine the exact degree of blondness of every individual seen, Mr. Stefansson feels safe in saying that more than half the individuals seen have eyebrows lighter than black and ranging all the way to a very light brown. The tendency to blondness seems less strong in the women than in the men. A few individuals had curly hair and perhaps a dozen had eyes noticeably lighter than the ordinary Eskimo brown, ranging to blue or blue-gray.

These and other facts of a similar character were observed by Mr. Stefansson and will, in due course, be published by the museum. It is too early to settle definitely on any theory explaining the facts. Of the various explanations that have so far been suggested it seems to Mr. Stefansson that the one open to the fewest serious objections is that of the admixture of a large amount of European blood at some fairly remote period. In this connection the disappearance in the fifteenth or sixteenth centuries of the Norse colony from Greenland suggests itself as a possible source of the European-like characters. Many things militate against the supposition that they can be derived from any of the Franklin expeditions of the middle of the last century; one of these is that the only Eskimo of this district seen at close quarters by Franklin himself is described by him in terms which fit very well the blond type found to-day ("Narrative of a Journey to the Shores of the Polar Sea in the Years 1819–1822," by John Franklin, Philadelphia, 1824, p. 316). The purely biologic theories that might explain the facts also seem to have their serious drawbacks.

RETIREMENT OF PROFESSOR HENRY SHALER WILLIAMS

Professor Henry Shaler Williams, of the department of geology of Cornell University, has retired from active teaching and has been appointed professor of geology, emeritus. In making the appointment the Board of Trustees adopted the following resolution:

The trustees of Cornell University desire to record their appreciation of the long and varied services of Professor Henry Shaler Williams and their regard for his high personal character.

A graduate of Yale University in 1868, he was afterwards in the service of that university and professor in the University of Kentucky. His connection with Cornell University began in 1879, when he was appointed assistant professor of geology, becoming later professor of geology and paleontology. He also discharged the duties of secretary of the faculty and was dean of the general

faculty from 1887 to 1892, when he was called to his alma mater as Silliman professor of geology. During this time he maintained as later an intimate connection with the United States Geological Survey and was associate editor of the *American Journal of Science* and *Journal of Geology* and a frequent contributor to other learned periodicals and societies.

In 1904 he was recalled to Cornell University as professor of geology and continued his work with the United States Geological Survey. He now retires to accept a pension under the Carnegie Foundation. The trustees desire to repeat the cordial expression of their appreciation of his ability and fidelity to the university which they recorded on his resignation in 1892. They further express the hope that he may long enjoy the facilities of the university to which he has generously contributed and continue his distinguished services to geological science.

SCIENTIFIC NOTES AND NEWS

DR. ALEXIS CARREL, of the Rockefeller Institute for Medical Research, has, according to cablegrams from Stockholm, been awarded the Nobel prize in medicine. Dr. Carrel, who was born in France in 1873, has carried forward important research work in experimental pathology, physiology and surgery.

SIR W. T. THISELTON-DYER, F.R.S., has been elected an honorary fellow of the Royal Society of South Africa.

THE Academy of Natural Sciences of Philadelphia has appointed Professor Allen J. Smith and Professor Hugo de Vries delegates to the dedication exercises of the Rice Institute, and Professor Henry Fairfield Osborn a delegate to the dedication exercises of the New York State Education Building.

PROFESSOR DUGALD C. JACKSON, head of the department of electrical engineering of the Massachusetts Institute of Technology, has been given leave of absence until January first and has gone to England at the British government's request. When the English Post Office Department considered the purchase of the different telephone lines, it determined to call one authority outside the country to work with the English commission. The selection of the government was Professor Jackson, who is now called to England for the final work of appraisal.

PROFESSOR W. J. HUSSEY, director of the Detroit Observatory of the University of Michigan, is at present engaged, as has been reported in SCIENCE, in the reorganization of the Astronomical Observatory of the University of La Plata, Argentina, of which also he is director. Professor Hussey was granted eighteen months' leave of absence from Michigan last spring in order that he might carry forward the plan of cooperation between the observatory at Ann Arbor and the similar institution in the southern hemisphere. He left for the south last June and since that time has been followed by Messrs. P. T. Delavan and B. P. Dawson, both of whom have been trained in astronomical work at Michigan. Mr. Delavan returns to Argentina, where he was a member of the Carnegie expedition for the observation of fundamental stars in the southern hemisphere. The fourth member of the present expedition to the La Plata Observatory was Mr. H. J. Colliau, the Detroit Observatory instrument maker, who sailed on August 20 to join Professor Hussey and assist in the reconstruction of the instrumental equipment of the southern institution. With Mr. Colliau went a shipment of machinery, tools and supplies to equip the new observatory shop which Professor Hussey is having built at La Plata. Dr. Sebastian Albrecht, formerly of the Lick Observatory, and more recently first astronomer of the Argentine National Observatory at Cordoba, has been appointed junior professor of astronomy in the University of Michigan. During Professor Hussey's absence the Detroit Observatory of the University of Michigan is in charge of Professor R. H. Curtiss, the assistant director.

PROFESSOR HENRY FAIRFIELD OSBORN gave the address published in this issue of SCIENCE on behalf of the State Museum at the ceremonies in Albany connected with the dedication of the new museum quarters in the Education building on October 15. On the evening of that day a commemorative dinner was given

by Director Clarke to Professor Osborn and to the past and present members of the State Geological Survey staff at which covers were laid for about forty guests. Among those present were Dr. Charles D. Walcott, Dr. George F. Kunz, Professor James F. Kemp, Professor H. P. Cushing, Professor H. S. Williams, Professor Charles Schuchert, Dr. H. S. Fairchild, Dr. E. O. Hovey, Dr. C. S. Prosser, Dr. E. O. Ulrich, Dr. E. M. Kindle, Dr. P. E. Raymond, Dr. C. R. Eastman, Dr. H. B. Kümmel, Dr. John C. Smock, Dr. J. B. Woodworth, Professor Gilbert Van Ingen, Dr. J. H. Stoller, Dr. C. P. Berkey, Professor H. P. Cleland, Professor C. E. Gordon, Professor A. W. Grabau, Dr. W. D. Matthew, Professor T. C. Hopkins and Professor W. J. Miller.

The scientific and operative staff of the Pennsylvania Chestnut Tree Blight Commission is now completed, and is as follows:

Pathologist—F. D. Heald, until recently professor of botany in the University of Texas.

Field Pathologist—Paul J. Anderson.

Entomologist—A. G. Ruggles, previously associate entomologist of the Minnesota State Experiment Station.

Forester in Charge of Utilization—J. P. Wentling, recently professor of sylvics in the Minnesota State School of Forestry.

Physiologist in Charge of Tree Medication—Caroline Rumbold, formerly of the Missouri Botanic Garden.

Geographer—F. P. Gulliver, formerly of the U. S. Geological Survey.

Tree Surgeon—Roy G. Pierce, formerly of the U. S. Forest Service.

Chemist—Jos. Shrawder.

Assistant Pathologists—W. H. Elza, R. D. Spencer, C. A. Gates, D. C. Babcock, J. F. Burrows and R. C. Walton.

Mr. Joseph C. Bock, formerly instructor in chemistry at Michigan Agricultural College, has been appointed chemist in the Nutrition Laboratory of the Carnegie Institution of Washington, Boston, Massachusetts.

Mr. James H. Gardner, formerly assistant geologist on the U. S. Geological Survey, who has recently been engaged in work on the clays, coals and oil fields for the State Geological Survey of Kentucky, has been engaged by the Topographic and Geologic Survey of Pennsylvania and given charge of the mapping and general study of the Broad Top Coalfield, with field headquarters at Hopewell, Pa.

Joseph F. Brewster, A.B. (Delaware, '98), Ph.D. (Berlin, '12), has been added to the staff of the chemical division of the North Carolina Agricultural Experiment Station at West Raleigh. He will assist in the investigation of the toxicity of cotton seed meal.

Waldemar T. Schaller, Ph.D. (Munich), mineralogist and chemist of the United States Geological Survey, has returned to duty after six months leave of absence. Most of the time was spent in Germany at the universities of Munich and Heidelberg, but nearly all the chief mineral collections of Europe were also visited and studied.

Professor Azariah S. Root, who returns to Oberlin College from a half-year leave of absence for study abroad, has completed some investigations in connection with the problems of early printing. Professor Root, who is professor of bibliography and college librarian, conducted special research work in the John Rylands Library, Manchester, England, the Bodleian, the British Museum, and the Bibliothèque Nationale in Paris, supplemented by later travel in Belgium and Holland to determine whether Johann Gutenberg of Mainz or Laurenz Coster of Haarlem was the originator of printing by movable types.

In the proceedings of the Minneapolis meeting of the American Association for the Advancement of Science, the death is announced of Charles Frederick Shaw, of State College, Pa., the name having been confused with that of Charles H. Shaw, of Ambler, Pa., who was drowned in Canada. Professor C. F. Shaw writes to the permanent secretary of the association: "I wish to say that to the best of my knowledge I did not die in 1911, nor have I been dead at any time since. At least my life insurance policy is still in force and I am carrying on the work that I have been doing during the past years. I have interviewed several of my co-workers, all of whom have assured me that I am still living and with this

evidence I believe I can at least say with Mark Twain 'that the report is grossly exaggerated.'"

AT the annual meeting of the American Association for the Study and Prevention of Infant Mortality, held in Cleveland, the following officers were elected to serve for the ensuing year: *President,* Dr. L. Emmet Holt, of New York; *president-elect,* Dr. J. Whitridge Williams, of Baltimore; *first vice-president,* Dr. Isaac A. Abt, of Chicago; *second vice-president,* Dr. Arthur D. Baldwin, of Cleveland; *secretary,* Dr. Philip Van Ingen, of New York; *treasurer,* Dr. Austin McLanahan, of Baltimore; *executive secretary,* Miss Gertrude B. Knipp, of Baltimore. The next meeting of the association will be held in Kansas City, Missouri.

DR. C. P. STEINMETZ gives each year a lecture in Chicago before a joint meeting of the Chicago Section of the American Institute of Electrical Engineers and the Electrical Section of the Western Society of Engineers. The lecture this year will be on October 28 and the subject is "Some Problems in Electrical Engineering."

ON the evening of October 3 Professor H. E. Jordan, of the University of Virginia, delivered an address on "Eugenics: the Rearing of the Human Thoroughbred," before the American Association for the Study and Prevention of Infant Mortality, meeting in Cleveland.

THE Royal Geographical Society, London, proposes to hold on March 17 a meeting commemorative of the centenary of the birth of David Livingstone, when Sir Harry Johnston will give an address and there will be an exhibition of Livingstone relics. At a date not yet fixed Sir Clements Markham will give an address in commemoration of the discovery of the Pacific Ocean in 1513 by Balboa.

THE Rev. Dr. Walter W. Skeat, professor of Anglo-Saxon at Cambridge University, died on October 7 at the age of seventy-seven years.

THE state of Minnesota has engaged Dr. Ernest B. Hoag, a health expert, to travel about the state and demonstrate to the citizens that rational conservation of the mental and physical health of children is possible and practicable with the means already at hand. Three plans are proposed: (1) Organization with a medical officer and a nurse or nurses; (2) organization with a school nurse or nurses only; (3) organization by the employment of a simple non-medical health survey on the part of the teacher only. To make it possible for every community, however small, to possess the necessary technical knowledge, the state board of health will maintain at the state capital a "clearing house of information concerning child hygiene, medical supervision, the teaching of school hygiene and the like."

UNIVERSITY AND EDUCATIONAL NEWS

A HUNDRED thousand dollars to endow scholarships for young men has come to the University of California through the decree of final distribution for the estate of Mrs. Carrie M. Jones, of Los Angeles.

MOUNT HOLYOKE'S alumnæ committee reports that its efforts to raise a half million dollar fund for the college have met with success. The committee has turned over to President Woolley vouchers for $552,000. Of this amount $100,000 is to be devoted toward a $125,000 student-alumnæ building.

THE trustees of Columbia University announce that under the will of the late Augustus W. Openhym an endowment had been established for research work into the cause, prevention and cure of cancer. The amount of the gift was not made public, but it was said the sum was considerable. If at any time further research into cancer shall no longer be necessary, Mr. Openhym's will stipulates that the income may be used for research work in any branch of medicine or surgery. The endowment under Mr. Openhym's will is to be known as the Openhym Research Fund, and the terms of the gift are substantially the same as those of the Crocker Research Fund which amounts to $1,440,000. The authorities of Columbia University plan to combine the two endowments.

ON September 24 ground was broken, as we learn from the *Journal* of the American Med-

ical Association, by Dr. Edgar F. Smith, provost of the University of Pennsylvania, and former Mayor Weaver, for the Thomas W. Evans Museum and Dental Institute, at Fortieth and Spruce Streets. The ceremonies were attended by the deans of the University of Pennsylvania, members of the faculty of the University Dental School, representatives of the various dental alumni associations and the French and English consuls. The building is expected to be completed in the fall of 1913 and, according to the plans, will be the largest and best equipped dental school in the world, supported by an endowment of $600,000. The building will cost about $500,000. The Museum and Dental Institute will be under the administration of the university. Dr. Evans, the famous Paris dentist in Louis Napoleon's reign, was a former Philadelphian who died in Paris in 1897.

In conjunction with the state department of health, the medical school of the University of Wisconsin has established a course extending over one year and leading to a diploma in public health. This course will be open only to those who have received a degree in medicine or a degree in medical or sanitary science. The full course for the present college year includes work in nine different fields and is intended to give a comprehensive survey of public health work. How certain diseases may be transferred from animals to man, and how to combat diseases resulting from employment at unhealthful occupations, are two of the things that will be studied. To show students the results of improper lighting and ventilation systems in factories and school houses, etc., special trips will be made by the class. Inspection trips to slaughter houses, meat markets, dairy barns and other places which may have a vital effect upon the health of a community will also be made.

The forty-first session of the College of Medicine of Syracuse University began October 1 with 31 students registered in the entering class and three entered with advanced standing. At the opening exercises Chancellor James R. Day spoke to the students and Professor Henry L. Elsner gave the opening address, "Traditions and Ideals." Dean Heffron announced the changes that had been made in courses and in instructors, most important of which were: The creation of an independent department of bacteriology, to the head of which Professor Leverett Dale Bristol, A.B. (Wesleyan), M.D. (Johns Hopkins), was called from Minneapolis. The election of Earl V. Sweet, A.B. (Colgate), M.D. (Cornell), as instructor in histology. The election of Mr. John R. Rice, B.S. (Wesleyan), to be instructor in the department of hygiene and preventive medicine and assistant in the Municipal Laboratory. The election of Albert G. Swift, M.D. (Syracuse), of New York City, to be instructor in clinical surgery. The election of John W. Cox, M.D. (Syracuse), as instructor in pathology. Dr. Frank P. Knowlton, professor of physiology, has returned from a year's leave of absence spent in the University of Cambridge and University College, London. A plan was inaugurated by which each student shall have control of a special microscope which he shall own at the end of his course. The contract for the new College Dispensary has been let and work has begun on the building.

Dr. Edward Thompson Fairchild, of Lawrence, Kans., superintendent of public instruction of that state and president this year of the National Education Association, has been elected president of the New Hampshire College.

The vacancy in the department of philosophy at De Pauw University caused by the resignation of Dr. William G. Seaman, who has been elected president of Dakota Wesleyan University, has been filled by the election of Frederick M. Harvey, Ph.D. (Boston, '11).

Glen Z. Brown, Ph.D. (Penna.), has been appointed professor in chemistry in Bucknell University.

At the University of Minnesota many new appointments have been made. Robert B. Gibson has been made assistant professor of physiologic chemistry; Walter E. Camp and

Elmer R. Hoskins, assistant demonstrators in anatomy. Alois F. Kovarik, of the department of physics, and Herbert H. Woodrow, of the department of philosophy and psychology, have been advanced to the rank of assistant professor. In the agricultural college numerous changes in titles and promotions include J. P. Wentling, from assistant to associate professor of forestry; A. R. Kohler, from instructor to assistant professor of horticulture; J. L. Mowry, from instructor to assistant professor of agricultural engineering; H. B. Roe, in mathematics, W. H. Frazier, in soils, W. L. Oswald, in agricultural botany, Rodney M. West, in agricultural chemistry, A. C. Arny, in agronomy, were all advanced from rank of instructor to assistant professor. A. M. Bull was advanced from instructor in engineering to engineer in charge of buildings with rank of assistant professor. In the college of medicine and surgery the following promotions and changes in title were made: W. P. Larson, bacteriology and pathology, H. P. Ritchie, surgery, F. L. Adair, obstetrics and gynecology, A. S. Hamilton, mental and nervous diseases, E. S. Strout, ophthalmology and otology, Henry L. Williams, gynecology, Wm. A. Hilton, histology and embryology, were all advanced to the rank of assistant professor from that of instructor.

DISCUSSION AND CORRESPONDENCE

GYROCOCCUS FLACCIDIFEX AND THE "FLACHERIE"

IN SCIENCE, August 16, Mr. R. W. Glaser and Mr. J. W. Chapman report the discovery of the specific organism which causes "Flacherie" in the gypsy moth caterpillar, and have named it *Gyrococcus flaccidifex.* The communication which pays a handsome and well-deserved compliment to similar work done in Germany on closely related forms, has complacently pronounced "some of the attempts made in this country" to be unscientific. In this very generalized criticism direct reference is made to my paper of 1911.[1] Since a number of statements and their general tone are misleading, a brief correction is not out of place.

In my paper of 1911, the following contentions were made:

1. That the epidemic flacherie can be induced by special methods in feeding healthy gypsy moth caterpillars.

2. That, having obtained material thus diseased, it is possible to spread the epidemic flacherie by hanging bags of this dry, dead material in healthy caterpillar colonies.

3. That by obtaining diseased material early and hanging it soon after the caterpillars have hatched in the field we have a very efficient means of preventing serious damage, because the disease destroys the greater number of larvæ at early stages.

The authors in their study of the flacherie decide that:

1. This work is unscientific.

2. That it seems very improbable that any such methods as are at present utilized for the artificial spread of flacherie will be of any avail.

It is hardly conceivable that two entomologists should insist that another entomologist must work on the bacteriological side of this problem in order to be scientific. Competent bacteriologists, such as Dr. H. N. Jones, working under the direction of Dr. Theobald Smith, of the Harvard Medical School, have already attacked the bacteriological side of this problem, and report negative results in seeking the specific organism.[2] Of course, it is possible that an organism which can be seen with simple staining methods or with no stains at all might have been overlooked by the bacteriologists. The authors admit that *Gyrococcus flaccidifex* can be obtained in great numbers. When a healthy caterpillar is inoculated with a pure culture of *Gyrococcus* and dies in a limp or flaccid state, how can any one be sure that this is the same as

[1] Reiff, William, "The Wilt Disease, or Flacherie, of the Gypsy Moth. How to aid the Spread of this Disease." Boston, 1911. Wright & Potter Printing Company.

[2] Jones, Dr. J. N., "Further Studies on the Nature of the Wilt Disease of the Gypsy Moth Larvæ," in *The State Forester of Massachusetts,* Seventh Annual Report, 1910.

death from the organism which causes the epidemic flacherie? There are undoubtedly many organisms which might cause the death of a caterpillar and a subsequent limp condition.

I do not wish to dictate or discuss what makes a piece of work scientific or unscientific, for that is out of my sphere; but I have previously stated my own incompetency to work on bacteriology in relation to the problem of the epidemic flacherie.[3]

The authors state that they have no experimental evidence that the disease may be air-borne but do not wish to exclude such a possibility. Bolle,[4] Prowazek[5] and Wahl[6] have used methods involving dry infection, working on the flacherie of either the silk worm, or nun moth or both. All of these investigators have also used dry cultures at least a year old with positive results. This would give some reason to believe that dry infection may be possible in the flacherie of the gypsy moth. Wahl used methods in combating the nun moth, showing that the disease was air-borne. Glaser's and Chapman's experiments as given in their table deal only with wet infection and no inferences involving the various phases of dry infection can be legitimately drawn. From my own paper of 1911 and later work, as yet unpublished, it is apparently evident that the epidemic flacherie (very possibly different from the disease which Glaser and Chapman induced) is also air-borne. In this disease it is entirely unnecessary to feed the caterpillars with my culture or inoculate individuals with large numbers of *Gyrococcus flaccidifex* or some organism that is unknown in order to produce an epidemic of flacherie and death. Whatever the organism may be which causes epidemic flacherie, it is certainly spread with ease and kills young larvæ after the first instar, no matter what the weather or food conditions may be. Glaser and Chapman have not considered secondary hosts, other stages of their bacteria or virulent strains.

Unfortunately the term "flacherie" is very indefinite, but it has long been suspected that a number of different diseases are included in this term. That disease which expresses itself as an epidemic of flacherie may be due to one or a number of organisms or stages of organisms. More work by the bacteriologists will be heartily welcomed.

William Reiff

Forest Hills, Mass.

[3] Reiff, William, "Some Experiments on Flacherie in the Gypsy Moth," *Psyche*, Vol. XVI., No. 5, Boston, 1909.

[4] Bolle, J., "Vorläufige Mitteilungen über die Gelbsucht der Seidenraupe," *Atti e Memoire dell' i. r. Società agraria*, Görz, 1894.

[5] Prowazek, Dr. S., "Chlamydozoa," *Archiv für Protistenkunde*, 10. Band, Jena, 1907.

[6] Wahl, Dr. Bruno, "Uber die Polyederkrankheit der Nonne (*Lymantria monacha* L.)," *Centralblatt für das gesamte Forstwesen*, Heft 6, Wien, 1911.

A NEW FLY TRAP

To the Editor of Science: In these days of general campaigning against the house fly, it may be of passing interest to the readers of Science to know that we have constructed at this station a fly trap which catches flies in such wholesale numbers that its merits are apparent to any one. So successful have we been that we have ventured to call it "The Minnesota Fly Trap."

The trap is twenty-four inches long, twelve inches high and eighteen inches across, the material consisting of a very little lumber and wire mosquito screen, costing 41 cents. A good carpenter can make one in one to three hours.

The director of this station felt the need of locating on the campus some fly traps which would capture flies in large numbers and as a result of his expressing the desire, this trap was constructed.

We find bread and milk (if more attractive food is not exposed) frequently renewed, to form the best bait. The following record shows how useful this contrivance is. In one day in the dairy barn, it caught 1,700 flies; rear of dining hall, two days, 3,000 flies; same place, five days, 13,000 flies; same place, one day, 4,200 flies; on the back porch of a dwelling house not far from a stable containing a

few horses, one day, 12,000; same place, one and a half days, 18,800 flies.

The writer would be very glad to mail illustrated leaflet describing this trap to any one desiring the same.

F. L. WASHBURN
MINNESOTA EXPERIMENT STATION,
ST. ANTHONY PARK, MINN.,
August 19, 1912

SCIENTIFIC BOOKS

Technical Methods of Chemical Analysis. Edited by GEORGE LUNGE, Ph.D., Dr. Ing., Emeritus Professor of Technical Chemistry, Federal Polytechnic School, Zürich. English Translation from the latest German Edition, adapted to English conditions of manufacture. Edited by CHARLES ALEXANDER KEANE, D.Sc., Ph.D., Principal and Head of the Chemistry Department, The Sir John Cass Technical Institute, London. Volume II., 2 parts, pp. xxvii + 1,252. New York, D. Van Nostrand Company. 1911. Price $18.00 net.

The Manufacture of Sulphuric Acid and Alkali with the Collateral Branches. A Theoretical and Practical Treatise. By GEORGE LUNGE, Ph.D. Third Edition. Volume III., Ammonia-Soda, Various Processes of Alkali Making and the Chlorin Industry, pp. xix + 764. New York, D. Van Nostrand Company. 1911. Price $10.00 net.

It is gratifying to know that such substantial progress has been made on the English translation of these two standard and almost indispensable works, and that only one volume of each remains to be published. It is indeed unfortunate that English translations should be needed, but the fact can not be ignored that a large proportion of our technical men do not read German, and that no work is really accessible to them unless it is printed in English. Even the younger generation, who have been compelled in their technical school training to use both German and French, seem in a great hurry to drop their knowledge of these languages as soon as they get out at work.

One general criticism may be passed on both of these books. They have been prepared and edited largely from an English standpoint, and American practise has been to far too great an extent ignored. There has been great development in recent years, both along the line of rapid methods of technical analysis and also in standardizing analytical methods, and along both these lines American chemists have been by no means backward, yet under Iron and Steel there are but 19 footnote references to American literature against more than 100 to English and more than 130 to German sources, and under Illuminating Gas and Ammonia but five out of 140 references are to American publications or apparatus. We also note that under Copper no reference is made to the use of a platinum gauze kathode in electrolytic deposition, nor under Lead to Low's modification of Alexander's method in the presence of calcium. It would have given a broader value to the first book had it not been quite so exclusively "adapted to English methods of manufacture."

Aside from this criticism the reviewer has nothing but favorable comment for both these books. In this second volume of Technical Methods, the following subjects are treated: Iron, by Dr. P. Aulich; Metals other than Iron, and Metallic Salts, by Professor O. Pufahl; Artificial Manures, by Professor O. Böttcher; Feeding Stuffs, by Dr. F. Barnstein; Explosives, by Oscar Guttmann; Matches and Fireworks, by Dr. A. Bujard; Calcium Carbide and Acetylene, by Professor Lunge himself and Dr. E. Berl; Illuminating Gas and Ammonia, by Dr. O. Pfeiffer; Coal Tar, by Dr. H. Köhler, and Organic Dyes, by Professor R. Gnehm. These comprise the subjects included in the second and third volumes of the new German edition, together with the section on Organic Dyes from the fourth and last volume. Under each head are given quite fully the standard methods of analysis of all the products connected with the industry, and at least an outline of other methods which promise to be improvements. In each case references are given to the orig-

inal sources. The book is brought well down to date, and is conspicuous by the absence of descriptions of antiquated methods which have only a historical interest. Covering, as it does with the other volumes, the whole field of the analytical chemistry of technical products, the book is indispensable to the library of every analytical chemist.

The other book under review has since the publication of its first edition been recognized as the standard work on the manufacture of sulfuric acid and alkali. This third volume was in earlier editions the concluding volume, but, so great has been the development of electrolytic methods of manufacture in recent years, it has been found necessary to add a fourth volume, which is shortly to appear, and which is to include the electrolytic manufacture of alkali and chlorin. This will be prepared by Professor Askenasy and Professor Haber, recognized authorities on the subject. The work of Dr. Lunge is concluded with this third volume, which is devoted to the ammonia-soda process, processes for the manufacture of soda other than the LeBlanc and the ammonia-soda, and to the manufacture and utilization of chlorin. This last section includes bleaching powder and other bleaching liquors and compounds, and the chlorates.

It is rather striking that in as important industry as the manufacture of soda, the methods all but exclusively used throughout the nineteenth century were the LeBlanc, first put in operation before the century opened, and the ammonia process, suggested at least early in the century. Further, while the mechanical details, of course, were greatly improved, there was practically no change in the chemical principles involved. Curiously the first suggestion of the ammonia process seems to have come from Fresnel in 1811, but "the invention soon sank into oblivion, and Fresnel himself, whose thoughts were later fully occupied by his magnificent reforms in the domain of optics, did not give any more time to it." John Thom, a chemist in the factory of Turnbull and Ramsay in Scotland, actually worked the process, including the ammonia recovery in 1836, but it was later abandoned, though his other practise of utilizing the ammonia residues as manure won for Thom the merit of founding the industry of artificial fertilizers. In 1838 the first patents on the process were taken out by Dyar and Hemming, and various manufacturers experimented with it, but in the hands of none did it prove a commercial competitor with the LeBlanc. The mechanical difficulties were great, and then, owing to the recovery of the chlorin by-products, the LeBlanc process has always been able to compete with the ammonia method. It was not till 1861 that the Belgian Solvay began independently the development of the ammonia process, now perhaps more commonly known as the Solvay process, and soon placed it on a commercial basis. Since that time the output has steadily increased, passing that of the LeBlanc process about 1888, and from that time the production by the latter process has constantly declined. In this country the LeBlanc process has never been worked, while the ammonia process has had considerable development. Both these processes are now threatened, especially in this country, by the recent rapid development of electrolytic processes, which will in the near future probably drive the LeBlanc process to the wall.

The hundred or so pages of the book devoted to the description of "other processes" is interesting reading, but somewhat painful, representing as it does so many futile hopes. Not less than a hundred different methods, most of them represented by sometimes several patents, are referred to, and not one of them (excepting the cryolite process) is of appreciable commercial value at present. The same may be said of most of the suggested processes of chlorin manufacture, for it is hardly a rash prediction that these will all soon give way to the electrolytic manufacture. In the statistical tables at the end of the book we note that in 1904 half of the chlorin products the world over were from electrolytic chlorin, and that only in Great Britain and France was LeBlanc chlorin predominant. We also note that in 1895 the United States

produced 166,562 tons of alkali, less than was imported, while in 1900 the production was 539,541 tons and in 1905, 734,209 tons. In the last two periods the importation of bleaching-powder into the United States had decreased from 136,403 tons to 96,110 tons. Unfortunately this statistical portion is the only part of the book not brought well down to date.

J. L. H.

The Elements of Statistical Method. By WILLFORD I. KING, M.A. New York, The Macmillan Company. 1912. Pp. xvi + 250.

It is "the purpose of this book to furnish a simple text in statistical method for the benefit of those students, economists, administrative officials, writers, or other members of the educated public who desire a general knowledge of the more elementary processes involved in the scientific study, analysis and use of large masses of numerical data."

With this purpose in mind, the author presents only the most simple of the mathematical theorems on which the statistical method is based. The book is arranged so as to treat the subject in four main parts: (1) The historical development and general characteristics of statistics; (2) the gathering of material; (3) analysis of material collected; (4) comparison of variables. The great variety of topics dealt with under these general headings indicates the breadth of view desirable for an adequate treatment of statistical problems, and suggests the many pitfalls that endanger the certainty of conclusions drawn from some kinds of statistical data. The book is to be commended for the clearness with which it brings a large number of topics concerning statistics to the attention of the educated public. This is surely a matter of the highest importance.

It seems desirable to criticize the treatment of the notion of "the probable error." On p. 78, we find the following statement: "If $E =$ the possible error of the arithmetical average, the probable error of the same is approximately $E/\sqrt{n}$." For proof, we are referred to Bowley, "Elements of Statistics," pp. 303–315. I fail to find that Bowley attempts to obtain a relation between probable and possible errors. He does show, within the limits of this reference, that the probable error of the arithmetic mean of n variates is $E/\sqrt{n}$, where E is the probable error of a single variate. It seems to the reviewer that the book is not clear on the notion of a probable error, and even presents an incorrect conception of this subject. On pp. 213–214, the statement is made that the probable error of a coefficient of correlation varies inversely both with the number of pairs of items and with the size of the coefficient. Then the well known formula

$$\frac{0.67(1-r^2)}{\sqrt{u}}$$

is given for this probable error. It is therefore obvious that the author does not use the expression "varies inversely" in its usual meaning in mathematical sciences. Later, on p. 214, is the statement that the probable error indicates that the chances are that r actually lies between

$$r + \frac{0.67(1-r^2)}{\sqrt{n}} \quad \text{and} \quad r + \frac{0.67(1-r^2)}{\sqrt{n}}.$$

This statement is obvious but useless when taken in one sense. It tends to give an incorrect conception of the meaning of a probable error, when taken in another and important sense.

To summarize, it seems to the reviewer that the strength and usefulness of the book lies in its popular presentation of some of the leading ideas of the best statistical method of the present day. The weakness of the book lies in its presentation of a vague and even incorrect conception of the meaning of the probable error of a statistical result.

H. L. RIETZ

UNIVERSITY OF ILLINOIS

POPULAR AND TECHNICAL BOOKS ON HEREDITY

Einführung in die Vererbungswissenschaft. By RICHARD GOLDSCHMIDT. Leipzig, Wilhelm Engelmann. 1911. Pp. x + 502. Price, 12.25 M., paper, 11 M.

This book is one of several from German authors that have been welcomed by American students because of the want of a suitable text in our own language. In twenty chapters the author treats of variation and statistical methods, with their present and former application, mutations and fluctuations, inheritance of acquired characters, Mendelism, mechanism of heredity, graft hybrids, and sex-determination.

Statistical methods are discussed briefly, not as in a text-book of statistics and their manipulation, but merely to point out the kind of problem amenable to attack in this way. The author is, however, cautious in advocating statistical methods, pointing out as others, particularly Johannsen, have done, that mathematics without biological analysis is valueless. At the close of the discussion of biometrics, Galton's laws of regression and of ancestral contributions are briefly reviewed, but the view is advocated that these laws are no longer of biological value. In the conclusions drawn from the study of pure lines, the author is in substantial accord with Johannsen.

Mutations are regarded as probably not essentially different from fluctuations, the latter being capable, under certain circumstances, of becoming the former. This conclusion is based largely on the work of Tower. The question of mutations then becomes, What fluctuations may become heritable, and under what circumstances?

Prefatory to a discussion of acquired characters, much evidence is adduced to show a connection between somatic and germ cells. In this evidence is included the effects of gonad extracts upon somatic characters, though one may wonder what bearing this has upon somatic influence on germ cells. One misses the negative results obtained by Smith from injections in fowls, but the book was probably written too early to include this. Guthrie's transplantation experiments are accepted at par, though there seems good reason to doubt their validity.

The inheritance of acquired characters is believed, on the strength of the newer evidence, to be probable. Goldschmidt is the more ready to adopt this view because he regards mutations as only special forms of fluctuation. The theory of parallel induction (the simultaneous action of the environment on both soma and germ cells so as to produce identical variations in parent and offspring), which was supported by Tower's experiments on *Leptinotarsa,* meets, in the author's opinion, an insurmountable difficulty; but how simple induction (the effect of an already modified soma on the germ cells so as to produce the same modification in the offspring) encounters any less insurmountable difficulties, is not explained. They seem to the reviewer to be equally inconceivable.

The half dozen chapters on Mendelism constitute a treatise, for the most part elementary, in which are discussed the various cases of mono-, di- and poly-hybrids. Doubt is expressed as to whether species hybrids exhibit Mendelian behavior, on the ground that equality of reciprocal crosses is a rule of Mendelism, whereas in many species crosses the reciprocal crosses are distinctly unequal. The reviewer finds cases where reciprocal varietal crosses are also unequal. To explain intermediate F_1 the author accepts as probable the assumption that many genes combine to produce a single visible character.

The Sutton-Boveri hypothesis of the segregation of genes is rejected on the ground that there are cases in which there are more independently heritable characters than there are chromosomes, notwithstanding the fact that the existence of such cases has not been demonstrated to the satisfaction of all geneticists. In its place the author adopts a theory of end-to-end union of the chromosomes (telosynapsis) in such a way that either maturation division may be a reduction division, whereby the number of possible combinations is greatly increased. The individuality of the chromosomes is not maintained in this theory.

The chapters on sex-determination are perhaps one of the least satisfying parts of the book. This is partly owing to the unsettled

condition of the subject. One could wish, however, for a fuller analysis of the more important current theories. According to the author, secondary sexual characters afford no evidence fitted to solve the problems of sex. The evidence of Mendelian inheritance of sex is strongest in sex-limited inheritance; but even here a non-Mendelian hypothesis is held to be better. Sex-determination is a phenomenon of cell physiology and cell regulation. "To say more would certainly be premature."

Several minor criticisms might be made. Typographical errors are infrequent. "Biotype" is made synonymous with "pure line" on page 122. One feels that the inheritance of acquired characters could be discussed more judicially after Mendelism, instead of before it. On the whole, however, the book is very well written and well made, and will be a valuable aid to both teachers and students.

The Heredity of Richard Roe. By DAVID STARR JORDAN. Boston, American Unitarian Association. 1911. Pp. 165. Price, $1.20.

Heredity in the Light of Recent Research. By L. DONCASTER. Cambridge, The University Press. 1911. Pp. 143. Price, 40 cents.

These two books are intended for the laity, and are excellently designed for their purpose. Richard Roe is a typical man, whose history is described from germ cell to manhood. The author's treatment of his hero is conditioned by his public, and is popular to a degree not usually combined with accuracy. Because the book will be read by the uninitiated, one feels that the case against prenatal influences, for example, could have been made stronger without compromising the author's scientific standing. There is considerable matter in the latter part of the volume that seems at first sight irrelevant to the heredity of Richard Roe. But the whole book is written in such delightful style, a style which those acquainted with the author will at once recognize, that differences of opinion regarding emphasis or relevance are quickly forgotten.

If Jordan's book furnishes inspiration, Doncaster's supplies information. The latter volume gives, in small compass, the main facts of heredity in a form readily grasped by any intelligent reader, yet with all the accuracy which the author's scientific reputation leads one to expect. Heredity is approached by the usual road, with a discussion of variation, its causes, and its study by statistical methods. The reader is given an elementary understanding of Mendelism, and is led within sight of some of the disputed questions regarding purity of gametes, inheritance of acquired characters, etc. Heredity in man, with its sociological bearing, closes the main part of the volume. Two appendices treat of the history of theories of heredity and the material basis of heredity. There is a short glossary, and a bibliography in which those books suitable for general readers are specially designated.

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A CLASSIFICATION OF THE DEPARTMENTS OF BOTANY AND AN ARRANGEMENT OF MATERIAL BASED THEREON

No one has made a serious attempt at the classification of the departments of botany. Various short classifications have been given in text-books with a view to arranging the facts presented to botanic students, but I am not aware that these have been made with a thought at presenting in logical sequence the divisions into which botany naturally may be divided. Such an arrangement is an important matter when the botanist wishes to arrange his books, photographs, microscopic and lantern slides, as well as museum material of plants. Recognizing the lack of such information, the attempt is made here to give a logical classification of the departments of botany, and it is hoped that the readers of SCIENCE will make additions and corrections, or suggest a rearrangement of this preliminary

and tentative scheme, which is presented in outline without definitions, which may be found in any large dictionary of the English language.

DEPARTMENTS OF BOTANY

I. *Systematic Botany.*
- Terminology.
- Nomenclature.
- Classification.
- Taxonomy.
- Phylogeny.

II. *Morphologic Botany.*
- Organography, including Morphogenesis.
- Biometry.
- Experimental Morphology.
- Teratology.
- Histology.
- Cytology.
- Embryology.

III. *Physiologic Botany.*
- Special Physiology.
- Phenology.
- Zymology.
- Genetics: Inheritance. Hybridization. Plant Breeding.

IV. *Ecologic Botany.*
- Ecology Proper.
- Anthobiology.
- Myrmecophily.
- Cecidology.

V. *Geographic Botany.*
- Distribution.
- Distributional Philosophy.
- Distributional Statistics.
- Floristics.
- Synecology.

VI. *Pathologic Botany.*
- Pathography.
- Etiology: Physiologic Pathology. Toxicologic Pathology. Bacteriologic Pathology. Fungologic Pathology. Entomologic Pathology. Chemic Pathology.
- Therapy.
- Prophylaxis.

VII. *Paleontologic Botany* (*Paleobotany, Paleophytology*).
- Paleography.
- Paleostratigraphy.
- Paleogenesis.
- Paleotechnics (Paleomechanics).

VIII. *Historic Botany.*
- Etymology.
- Biography.
- Synonymy.
- Bibliography.
- History of Botanic Work, Exploration and Discovery.

IX. *Philosophic Botany.*

X. *Ethnobotany.*

XI. *Applied Botany.*
- Cultural.
- Agricultural.
- Horticultural: Floriculture. Fruticulture. Olericulture. Viticulture.
- Forestal.
- Landscape Gardening.
- Esthetic (use of plants in decoration).
- Economic.
- Medical: Pharmacognosy: Pharmacoërgasy (culture, collection and harvesting of drugs). Pharmacoemporia (commercial handling of drugs). Pharmacodiakosmy (packing, etc.). Pharmacology. Pharmacodynamics. Phytotoxicology. Materia Medica.
- Educational.

The application of this scheme of classification is illustrated in the arrangement of a collection of lantern slides, according to the following:

CLASSIFICATION OF LANTERN SLIDES

SYSTEMATIC.—Arrangement according to Natural Families (see Engler's "Syllabus der Pflanzenfamilien," 1–314).

MORPHOLOGY (Spermatophytes).—The general and detailed structure of Angiospermæ and Gymnospermæ.

315. Seedlings.
316. Roots.
317. Stems and Buds.
318. Leaves.
319. Flowers.
320. Stamens and Pollen.
321. Pistil, including Ovary, Style and Stigma.

322. Fruits and Seeds.
323. Distribution of Fruits and Seeds.

HISTOLOGY (Pteridophyta).—Minute microscopic anatomy. See systematic slides for other details and embryology for details of development, etc.

324. Anatomy of Root.
325. Anatomy of Stem.
326. Anatomy of Leaves.
327. Anatomy of Other Parts.

(Gymnospermæ). Microscopic Anatomy. See embryology for details of fertilization and embryonic development.

328. Anatomy of Root.
329. Anatomy of Stem.
330. Anatomy of Leaves.
331. Anatomy of Other Parts.

(Angiospermæ).

332. Cells in General.
333. Cytoplasm.
334. Nucleus and Division. The slides are arranged alphabetically according to the author's name.
335. Cell Contents. Plastids; Starch; Aleurone Grains; Inulin; Crystals and Cell Sap.
336. Cuticle and Epidermis (Hairs, Glands and Pitchered Leaf Surfaces).
337. Tissue and Tissue Differentiation.
338. Organs of Secretion and Milk Tubes.
339. Anatomy of Roots.
340. Anatomy of Stems.
341. Anatomy of Leaves.
342. Stomata.

EMBRYOLOGY. Fertilization, development of embryo. Fertilization in lower plants (algæ, fungi, mosses) given with systematic slides.

343. Pteridophyta.
344. Gymnospermæ.
345. Angiospermæ.

PHYSIOLOGY.

346. Apparatus and Materials.
347. The Structure and Properties of Protoplasm (see histology under the head of Cytoplasm).
348. Nutrition of Plants.
   (*a*) Absorption of Water and Dissolved Minerals.
   (*b*) Transfer of Water and Minerals.
   (*c*) Transfer of Elaborated Substances.
   (*d*) Absorption of Gases.
349. Transpiration and Apparatus.
350. Metabolism. Phytosynthesis; Respiration; Fermentation; Nitrogen Assimilation; Use of Minerals; Formation of Special Substances; Storage; Secretion; Excretion (see slides under histology).
351. Growth; Increase in Size; Measurements; Effect of External Conditions; Movements.
352. Reproduction (see slides classified systematically under algæ, fungi, mosses and embryologic slides under embryology).
353. Genetics. Hybrids and New Races produced by Plant Breeding.
354. Irritability. Geotropism; Heliotropism; Hydrotropism; Thigmotropism; other tropisms and manifestations of irritability.
355. Locomotion.

ECOLOGY. For some slides illustrating relationship of flowers, insects, etc., see morphology. For slides illustrating some xerophytes, hydrophytes, mesophytes, see systematic slides and histology for microscopic structure. For distribution of seeds and fruits, see morphology.

356. Parasitism (see morphology).
357. Mycorhiza, Mycodomatia and Leguminous Tubercles. See Physiology under Nitrogen Assimilation.
358. Commensalism.
359. Cecidology (Galls).
360. Honey Dew and Plant Lice.
361. Fungi and Ants. (Extra-floral Nectaries.)
362. Pollination of Flowers.

GEOGRAPHY.

363. Maps illustrating Distribution of Species.
364. Statistic Charts of Distribution.
365. Photographs of Plant Formations; Associations and Societies. General Views of Plants under various Environmental Surroundings.

PATHOLOGY.

366. Diseases of Plants due to Insects. (For galls see Cecidology under Ecology.)
367. Diseases due to Fungi. Diseases of field and greenhouse plants; destruction of wood and timber; methods of study; inoculation; culture of diseased, as contrasted with healthy plants; laboratory methods; instruments; culture growths.
368. Diseases due to Climate.
369. Diseases due to Chemics (Gases, etc.).
370. Diseases that are purely Physiologic.

PALEOBOTANY. For plants see under head of systematic slides.

371. Slides illustrating various fossil plants.

372. Instruments used in preparation of fossils for microscopic study.
373. Slides illustrating ancient vegetation in landscape reproductions.

Historic Botany.

374. Photographs of Noted Botanists.
375. Reproductions of Ancient Botanic Books.
376. Maps illustrating Routes of Botanic Travel.

Ethnobotany.

377. Cultural and Medicinal Plants of Indians.
378. Views illustrating Aboriginal Uses.

Applied Botany.

(*Cultural.*)

379. Variations.
380. Mutation (Sports).
381. Selection.
382. Propagation. Methods of Crossing illustrated; hybrids and hybridization; cuttings; grafting; methods of seed planting and care of seedlings.
383. Implements used in Agriculture and Horticulture.

Agriculture.

384. Preparation of Soils.
385. Application of Fertilizers (Visible Results of Application).
386. Cultivation of Crops.
387. Harvesting of Crops.
388. Preparation of Crops for Use.

Horticulture.

389. Greenhouse and Greenhouse Construction.
390. Culture of Greenhouse Plants.
391. Floriculture.
392. Fruticulture.
393. Olericulture.
394. Viticulture.

Forestal.

395. Preparation of Seed Bed.
396. Care of Young Trees.
397. Methods of Thinning.
398. Character of Forest (Pure, Mixed).
399. Relation of Trees to Soil, Light, etc.
400. Methods of Cutting.
401. Methods of Lumbering.
402. Sawing and Dressing.
403. Tools used in Forestal Operations.
404. Gathering of Secondary Products. Faggots, Turpentine, Sugar, Fruits and Seeds.
405. Trees in General.
406. Botanic Landscapes.

Landscape Gardening.

407. Japanese Gardens.
408. Italian and French Gardens.
409. Formal Gardens.
410. Natural Gardens.
411. Garden Plans, etc.

Esthetic Botany.

412. Plants and Flowers in Decoration.
413. Conventionalized Plant Parts for Wall-papers and Tapestries.
414. Artificial Flowers, etc.

Economic Botany. For figures of economic plants and their parts, see under systematic classification.

415. Food Plants in General.
416. Root Foods.
417. Stem Foods.
418. Leaf Foods.
419. Fruit Foods.
420. Farinaceous Products (see under histology, No. 335).
421. Spices.
422. Plants used in Textile Industries.
423. Tanning Plants.
424. Dye Plants.
425. Rubber Plants.
426. Gum-yielding Plants.
427. Oil-yielding Plants.
428. Building and Furniture.
429. Methods of Gathering.
430. Methods of Shipment.
431. Methods of Preparation.
432. Methods of Manufacture.
433. Machinery.
434. Packing for Sale.
435. Methods used in Sale and Distribution.

Medical Botany. For illustrations of medical plants see systematically arranged slides.

436. Culture of Drugs.
437. Collection and Harvesting.
438. Handling of Drugs.
439. Packing of Drugs.
440. Manufacture into Medicines.

Educational Botany.

441. Photographs of Home and Foreign Botanic Gardens.
442. Laboratory Buildings.
443. Laboratory Equipment.
444. School Gardens.
445. Students at Work.

The slides are all numbered according to the plan outlined above, and if more than one slide is to be classified with a given number, an additional number is added according to the decimal system of card indexing. Thus 442.1, 442.2, 442.3, etc., would indicate that

there are several lantern slides illustrating the laboratory buildings of the world. The system of classification is thus made elastic.

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THE NEW CATALOGUE OF CHIROPTERA IN THE BRITISH MUSEUM

DURING the past twenty-five years the study of recent mammals has been pursued with an activity unprecedented in the history of other groups of vertebrates. Collections aggregating hundreds of thousands of specimens have been brought together, mostly by three or four museums, and the number of known forms whose existence was previously unsuspected has increased so rapidly that only a few specialists are fully aware of what has been taking place.[1] The trustees of the British Museum have recently issued the first volume of a second edition of the Catalogue of Chiroptera.[2] This is the first monographic treatment of a large group of mammals in which the systematic activities just alluded to are adequately summarized. Its interest is therefore twofold: to systematists an account of the technical matter which it contains, and to general zoologists as the first definite indication of the extent to which currently accepted ideas regarding the world's mammal fauna must be revised.

The volume now issued, containing more than 900 pages, is by Mr. Knud Andersen, who has spent nearly seven years in its preparation. It deals with the Megachiroptera, the old world fruit-bats, only. No group of mammals has ever been treated in such detail, and it is doubtful whether any work of similar size on any group of vertebrates contains so large and so well arranged a mass of original observations. The number of forms recognized is 228, distributed among 38 genera and subgenera. These are represented in the British Museum by 1,470 specimens and all but 21 of the species and subspecies.[3] In the first edition of the catalogue (Dobson, 1878) the Megachiroptera occupy 98 pages, with 78 forms and 13 genera and subgenera, represented by 425 specimens. This increase of nearly 300 per cent. is probably less than may be expected among the "insectivorous" bats (Microchiroptera). Mr. Andersen's studies of the Microchiropterine genus *Rhinolophus* resulted in an increase of from 21 to 105 or more, while his "Monograph of the Chiropteran Genera *Uroderma, Enchisthenes* and *Artibeus*," shows the old genus *Artibeus* with its six forms, as understood by Dobson, to consist of 32 forms representing three distinct genera. The number of bats known to Dobson was about 440; it is to be expected that the number recorded in the new edition of the catalogue will exceed 2,000. The significance of this increase will be understood when it is recalled that the entire number of living mammals is generally supposed to be about 5,000, a total in which the bats form about one tenth.

In general plan the present volume agrees with the original edition and with the well-known form of the British Museum "Catalogues." With the increase of fineness in discrimination, however, greater detail of treatment has become necessary. To take an example at random: in the original edition the account of *Pteropus "medius"* occupies two pages; in Mr. Andersen's volume it covers seven and a half without counting two devoted to a race not recognized by Dobson. This increase is due chiefly to the more elaborate description of characters, but it is partly the result of greater detail in the bibliographic citations: for the period covered by three lines under the name *medius* by Dobson 25 lines are here required. Perhaps the most striking

[1] The field work which has led to this result was made possible by the invention of several types of small traps, not originally intended for scientific purposes.

[2] "Catalogue of the Chiroptera in the Collection of the British Museum," second edition, by Knud Andersen. Vol. I., Megachiroptera. London, printed by order of the trustees, etc., 1912. Actual date of publication, March 23, 1912.

[3] About 1,000 specimens in other museums were also examined. All of this outside material is carefully designated in the text or in footnotes.

special feature of the purely technical part of this work as compared with its predecessor is the different degree of importance accorded to cranial characters. For Dobson the skull scarcely existed. Thirty years ago "there were separate skulls of only half the number of species of Megachiroptera then in the collection, whereas now every species and subspecies in the museum, with one exception (*Pteropus aruensis*) is represented by at least one and often by a series of skulls." The original edition contains figures of the skulls of 17 species, of which only one is a fruit-bat. In the present volume the skulls of 47 species are figured,[4] and detailed cranial and dental measurements are given of practically every recognized form.[5]

Another aspect in which Mr. Andersen's work differs from Dobson's is the relatively greater space allotted to speculation on such general subjects as distribution, interrelationships, the relative primitiveness or specialization of species, and the meaning of structures. The interest of the volume is thus much increased, particularly because it is here that the greatest individual differences of opinion are likely to be encountered. It is easy, for instance, to follow the author in his generic, specific and subspecific "splitting" of the *Cynopterus* group; but when he remarks of *Sphærias* (p. 673) that: "It must use its incisors in a way different from that of its relatives, as clearly shown by their remarkably proclivous position and peculiarly modified shape," he appears to offer a greater unknown quantity to explain a less. That is, until some member of this group is known to feed on other substances than fruit pulp there is no reason to believe that the exact form of the small and mechanically unimportant incisor teeth is of consequence to the animals. Such teeth in any mammal appear to assume any form readily developed from a generalized type; and that special modes of use enter into the problem has not yet been shown, however currently it may be assumed.

From the point of view of the general reader the discussion of geographic distribution (pp. lxxv–xcii) is of unusual interest. Mr. Andersen here shows the fallacy of the popular idea that bats, having wings, roam where they will, and of the more pernicious notion that philosophizing is profitable without exact and detailed knowledge of facts.[6] He says (pp. lxxvi–lxxviii):

> The evidence afforded by the geographical distribution of bats has generally been considered of doubtful value. . . . This unwillingness or hesitation to place bats on an equal zoogeographical footing with non-flying mammalia would seem to be due, partly to the preconceived idea that owing to their power of flight bats must evidently have been able easily to spread across barriers which, in ordinary circumstances, are insuperable for wingless mammalia; partly to the fact that hitherto very often whole series of distinct forms have been concealed under one technical name. So long as (to mention only three cases among many) *Macroglossus minimus* was believed to range unchanged from the Himalayas to New Guinea, Australia, and the Solomon Islands (now two distinct genera, thirteen recognizable forms), or "*Cynopterus marginatus*" over India, Ceylon, Indo-China and Indo-Malaya (now six species, fourteen forms), or "*Rhinolophus ferrum-equinum*" uniformly over Europe, Asia and Africa (now numerous distinct forms) they were undoubtedly of questionable value as zoogeographical material. But these and similar anomalies invariably disappear as soon as modern methods of discrimination applied on vastly increased material render it possible to draw the lines of separation between the species (and their local modifications) somewhat more closely in accordance with the lines drawn by nature. The second argument referred to above, that the spreading of bats from one locality to

[4] With two exceptions the 85 illustrations are original pen drawings by Mr. A. J. Engel Terzi. Their quality leaves nothing to be desired.

[5] The fact that the tables of measurements contain maxima and minima only is one of the few details of plan open to adverse criticism. The main object of making a series of measurements of the same part in a number of individuals is to discover what is normal; we are here given the two records which are most unusual.

[6] One of the most persistent of modern zoological myths—the belief that the rabbit of Porto Santo has developed recognizable characters within historic times—arose from the failure to discriminate between the Mediterranean and central European races of a common mammal.

another must obviously have been greatly facilitated by their possession of wings, may in theory appear plausible enough, but when tested on the actual distribution of the species and subspecies it proves to be of much less importance than commonly supposed; it rests, in reality, on the confusion of two different things: the power of flight no doubt would *enable* a bat to spread over a much larger area than non-flying mammalia, but as a matter of fact, only in a very few cases is there any reason to believe that it has *caused* it to do so.[7] . . . A few of the more striking examples may be mentioned here: a species of *Pteropus* inhabits the island of Pemba, south of Zanzibar, but although the island is separated from Africa by a channel only 35–40 miles wide, not this particular species only, but the whole genus is unknown from any part of the adjacent continent;[8] although absent from Africa the genus *Pteropus* is distributed all over the Malagasy region,[9] and each group of islands . . . has its own peculiar species, intermigration between the groups of islands is unknown; the Epomophorine section of fruit-bats is distributed over the whole of the Ethiopian region (eight genera, nineteen forms), but not a single form has spread to any island of the Malagasy region; the *Pteropus melanotus* group of [five] species is distributed over the Andamans, Nicobars, Nias, Engano and Christmas Island (south of Java), and the whole group is confined to this chain of islands, no form having spread to the neighboring Malay Peninsula or Sumatra. . . . The fruit-bat faunas of the Malay Peninsula, Sumatra and Borneo are closely interrelated, like their mammalian faunas in general, but each has some distinct autochthonous forms of fruit-bats (Borneo even two autochthonous [?][10] genera), as it has of other Mammalia; the Javan mammalian fauna in general is more peculiar, both by the absence of some of the forms found in Sumatra and the Malay Peninsula, and by the greater percentage of autochthonous forms, and this is again borne out by the Megachiropterine fauna of the island . . .; the *Pteropus rayneri* group is represented probably all over the Solomon Islands, but it has differentiated into five distinct species, one in the Bougainville group, a second on Villa Lavella, a third in the New Georgia group, a fourth on Guadalcanar and a fifth on San Cristobal. This . . . tends to show that the present distribution of the Megachiroptera has not been influenced to any great, and as a rule not even to any appreciable, extent by their power of flight; if it had, the fruit-bat fauna of one group of islands could not, so commonly as is actually the case, differ from that of a neighboring group or continent, and the tendency to differentiation of insular species or forms would have been neutralized by the free intercourse between neighboring faunas.

GERRIT S. MILLER

[7] The preponderance of bats over the characteristic Indo-Malayan non-volant types in the fauna of the Andaman and Nicobar Islands appears to be an instance in which wings have played a part in distribution (Miller, *Proc. U. S. Nat. Mus.*, XXIV., pp. 790–791, May 28, 1902); the presence of a slightly modified species of *Nycteris*, a characteristic American type of bat, as the only indigenous mammal of the Hawaiian Islands is probably another case of the same kind.

[8] Conversely, six species of European bats (*Myotis myotis, M. dasycneme, M. emarginatus, Pipistrellus natusii, Eptesicus nilssonii* and *Vespertilio murinus*, although occurring on or near the west coast from Brittany northward, are not known to have become established in England.

[9] It ranges eastward "through the . . . Oriental and Australian regions to the Samoa Islands."

[10] Further exploration will probably show that both occur on the peninsula or in Sumatra.

SPECIAL ARTICLES

THE PRODUCTION OF SPERM ISO-AGGLUTININS BY OVA

I. If one allows unfertilized eggs of *Arbacia* to stand in a quantity of sea-water that does not exceed about ten times the volume of the eggs, the sea-water soon becomes perceptibly tinged with the red coloring matter of the eggs. If now a few drops of such supernatant sea-water be added to 2 or 3 c.c. of a milky suspension of active sperm of the same species, a strong agglutination of the sperms immediately ensues, producing sperm-masses easily visible to the naked eye. In the course of three to five minutes reversal takes place, the masses become converted into their constituent cells, and considerable activity may be observed after the reversal on microscopical examination. The substance which produces this phenomenon may be called a sperm agglutinin, and since it is produced by the same species, an iso-agglutinin.

This basic phenomenon was studied in three

ways: (1) In a test tube or vial containing 2 or 3 c.c. of a milky sperm suspension, as above described. (2) Drops of the sperm suspension and of the egg-extract may be placed side by side on a slide and connected under the microscope, so as to observe the inception and progress of the phenomenon. (3) The best method of studying the detail of the phenomenon is to mount some of the sperm suspension beneath a long cover glass supported by glass rods 0.5 to 1 mm. in diameter, and to inject a drop of the egg-extract with a capillary pipette into the suspension. If this be observed under a low power of the microscope, one sees that the drop fills with sperm exhibiting increase of activity, which immediately agglutinate into small masses, which then unite with great rapidity to form larger masses spaced throughout the drop. At the margin of the drop and the sperm suspension a ring of agglutinated sperms forms which ruptures in numerous places, each segment contracting to form a mass, so that the continuous ring becomes a chain of beads visible to the naked eye. The ring forms in a second or two and breaks into masses in two or three seconds. The agglutination is totally reversible, so far as the visible effect is concerned, and the freed spermatozoa, or some of them, appear to regain full activity; moreover, the spermatozoa between the masses are in active movement throughout.

The reversal of the reaction consists in the resolution of the agglutinated masses into their individual cells, but this does not mean a return to their original physiological condition; for if the agglutinating solution (egg-extract) be sufficiently strong, after a period of intense stimulation followed by agglutination and reversal, the movements of the spermatozoa gradually cease entirely and in ten minutes they are no longer capable of fertilizing ova dropped in with them.

The agglutination is a factor of (1) the activity and relative density of the spermatozoa in the suspension, and (2) of the strength of the agglutinating solution. The more active the sperms and the greater the density of the suspension (within certain limits) the more rapid is the onset of the agglutination and the larger the agglutinated masses. The agglutinating medium may of course be made to vary in strength, and hence in agglutinating power by various means, *e. g.*, by crushing ovaries and eggs in about their own bulk of sea-water, or extracting in distilled water, very powerful solutions may be made.

The agglutinating agent is not readily destroyed by heat. After boiling and maintaining at a temperature of 95° to 98° C. for about 70 minutes, the agglutinating action of a strong extract was very much reduced but was not entirely lost.

No other tissue of the sea-urchin, so far as observed, produces an agglutinating agent for the sperm of the species: (1) The serum from the body-cavity, whether of males or females, is entirely neutral and the spermatozoa swim in it normally. But the serum forms a powerful agent for extracting the agglutinin from the eggs after the latter are removed from the ovary, though in the intact animal in which the eggs are separated from the serum by the ovarian membrane no extraction of agglutinin takes place. (2) Large pieces of the intestine were cut up in sea-water or in distilled water, the latter especially extracting colored matters in large quantity; but no sperm agglutinin could be detected in the filtrate.

The agglutination reaction fixes the agglutinin, as is readily proved by the fact that it disappears from an agglutinated sperm suspension, if not present in excess. Whereas an equal dilution with sea-water of the original egg-extract is still highly agglutinative. The agglutinative substance, therefore, presumably enters into combination with some sperm substance acting in this respect similarly to its antigen.

II. The results are essentially the same for *Nereis,* except that the visible agglutination is not reversible to the same extent, a difference which is probably of purely secondary significance. Moreover, the agglutinin is produced by the eggs in sea-water only in small quantities before fertilization, but in very large quantities at the moment of fertiliza-

tion. The eggs of *Nereis* when obtained are in the stage of the germinal vesicle, whereas those of *Arbacia* have formed both polar bodies, and this is probably correlated with the different rates of secretion of the agglutinin. The agglutinin of *Nereis* is moreover much more thermolabile, being destroyed at 95° C. in ten minutes. In *Nereis* also it is difficult to test other tissues satisfactorily, as the animal is practically a bag of eggs when sexually mature, but such tests as were made indicate that the eggs alone secrete the agglutinin. In other respects *Nereis* is a more favorable form for study, as the sensitiveness of the spermatozoa is unsurpassed.

III. As regards the important question of specificity, it seems very probable *a priori* that a substance which is produced only by the eggs of a given species, and which is agglutinative for the sperm of that species should be specific. Now the egg-extract of *Nereis,* which agglutinates *Nereis* sperm, is entirely devoid of agglutinating effect on *Arbacia* sperm, so that there appears to be specificity of the *Nereis* agglutinin to this extent at least. But the egg-extract of *Arbacia,* on the other hand, is extremely toxic and agglutinative for *Nereis* sperm, so that in this case either the agglutinin from *Arbacia* eggs is not specific for its own sperm, or the egg-extract contains, in addition to the specific agglutinin, another toxic substance. The latter alternative is probable, as is shown by the fact that the serum of the cœlomic fluid of *Arbacia,* which is not in the least toxic or agglutinative for *Arbacia* sperm, is as strong an agglutinative agent for *Nereis* sperm as the egg-extract of *Arbacia.* The presence of at least two sperm agglutinating substances in *Arbacia* is therefore certain, viz., one in the egg-extract, which is agglutinative for *Arbacia* sperm, and one in the cœlomic fluid not agglutinative for *Arbacia* sperm but agglutinative for *Nereis* sperm. I assume, therefore, provisionally, that both are present in the egg-extract, and that the sperm iso-agglutinin of *Arbacia* eggs is probably specific.

This assumption is rendered more probable by an observation made only once, and at the end of the season, so that its repetition this year is impossible. I had preserved a strong egg-extract of *Arbacia* for seventeen days. This had been tested at various times with *Arbacia* sperm and found to retain its agglutinating power without any observable diminution. But on the seventeenth day, when the last *Nereis* of the season was brought in, I was surprised to find that the egg-extract in question had lost its agglutinating power on the *Nereis* sperm. The same sperm was agglutinable with an egg-extract of *Nereis* eight days old; so that the difficulty could not be with the sperm. And the same egg-extract of *Arbacia,* on retesting, was found to retain its agglutinating power on the *Arbacia* sperm apparently unaltered. The specific agglutinin is therefore relatively stable with reference to the conditions involved, and the non-specific agglutinin or toxin is relatively labile. It might, therefore, be possible to separate them also by heat or other means.

One of these would be to fix the non-specific agglutinin of *Arbacia* egg-extract with *Nereis* sperm, and test the filtrate for the persistence of the assumed specific agglutinin with *Arbacia* sperm. If the *Arbacia* agglutinin were found to persist after the filtrate had lost its *Nereis* agglutinating power, the presence of the two agents in the egg-extract would be demonstrated. Or if, after completely fixing the specific agglutinin of *Arbacia* egg-extract with *Arbacia* sperm, a *Nereis* agglutinating agent were still found, the same conclusion would be inevitable. Unfortunately, by the time this stage of the analysis was reached, the season for both forms was over, and this experiment must be postponed for a year.

IV. The egg-extracts contain not only an agglutinin for the spermatozoa, but also an aggregative agent, *i. e.,* a substance towards which the spermatozoa are positively chemotactic. This may be readily demonstrated by the form of the reaction when a drop of the fluid to be tested is injected into a sperm suspension beneath a raised cover glass. If an aggregative agent be present, a ring of spermatozoa forms at or within the margin of the

drop, depending on the strength of the agent, and a clear zone arises between this ring and the general sperm suspension. The clear zone is produced by migration of spermatozoa to the ring; in case the agent is very strong the ring expands, owing to immigration of spermatozoa, but the clear zone is never obliterated, no matter how much the ring may expand. In the case of *Nereis,* which has unusually large spermatozoa, the passage of spermatozoa across the clear zone to the ring may be readily studied under a low power of the microscope, and it gives the impression of a regular rain falling on the ring.

In the case of *Nereis* all acids tested are aggregating agents (CO_2, H_2SO_4, HNO_3, HCl and $CH_3 \cdot COOH$ were studied), but do not agglutinate, and alkalis (K, OH and NaOH only studied) are agglutinative but not aggregative. The sperm of *Nereis* is extremely sensitive to acids, reacting positively to $N/1{,}000$ H_2SO_4, HCl, HNO_3 and $N/2{,}000$ acetic, and to 1/200 dilution of a saturated solution of CO_2 in sea-water. The phenomena of aggregation were therefore studied, particularly in the case of *Nereis.* The sensitiveness of *Arbacia* sperm to acids is three or four times less than that of *Nereis* sperm, but the reactions are in the same sense.

If an acid or other aggregative agent alone be present in the drop tested in the suspension beneath a raised cover slip, the ring which forms is perfectly continuous and the individual spermatozoa are separate. If an agglutinin as well as an aggregative agent be present, the ring forms and breaks up into agglutinated masses. If the agglutinin alone be present no ring proper forms, or there is no outer clear zone, and agglutinated masses form within the drop as described. The egg-secretions give the double reaction.

V. Von Dungern's experiments (*Zeitsch. f. allgem. Physiologie,* I., pp. 34–55, 1902) are the only ones, so far as I know, in which the production of sperm agglutinins by ova was investigated, and he discovered only hetero-agglutinins, no iso-agglutinins. He did, indeed, describe the loss of motility of spermatozoa in egg-extracts of the same species, but he entirely missed the phenomenon of agglutination and its reversal. He reveals the reason for this failure by his remark that he always examined for the effect of the "egg-poison" about half an hour after its addition to the sperm; but the phenomenon of agglutination and its reversal are completed in about five minutes.

Von Dungern also made experiments on the production of immune sera by injection of ova and spermatozoa separately into rabbits, and found that both caused the production of a sperm agglutinin in the rabbit's serum. From this he concludes that both kinds of reproduction elements possess chemically identical complexes of molecules in the protoplasm. While this may be admitted as at least a very probable conclusion, his farther conclusion that fertilization does not depend upon any specific antagonism between ovum and sperm, but is conditioned by the similarity of their protoplasms, is not well founded, for the egg is a very complicated chemical system, and it certainly contains molecules antagonistic to sperm, even if, as von Dungern's experiments indicate, it also contains some that are not.

VI. The existence of sperm iso-agglutinins in ova offers the possibility of an explanation of the specificity of fertilization on the basis of the laws governing antigens and antibodies, if these agglutinins are specific, as is so strongly suggested by the experiments. The union of ovum and spermatozoon is not a process in which the sperm penetrates by virtue of its mechanical properties, but one in which a peculiarly intimate and specific biochemical reaction plays the chief rôle. A later publication will give the details of the experiments and a more complete analysis of the behavior of the spermatozoa in fertilization.

Frank R. Lillie

September 16, 1912

Preliminary Note on Pristina and Naidium

These two genera, *Pristina* and *Naidium,* of the aquatic oligochætes, have been combined and separated by recent systematists with quite startling rapidity. The former genus was first described by Ehrenberg in

1831, and *Naidium* by O. Schmidt in 1847. In 1875, Beddard combined them under the prior name. In 1900, Michælsen restored them as separate genera, and again combined them in 1909. These two genera are more alike than any other two genera in the family Naididæ, and than many species in some of the genera. They differ only in the development of the prostomium, which varies widely within the same species, and in the presence of bifid setæ in the dorsal bundles of *Naidium*. This is no more reason for keeping them apart than it would be to make *Nais tortuosa* and *N. parviseta* separate genera, because the latter has bifid setæ in the dorsal bundles. Michælsen, in recombining the two species, gives no reason for so doing; but Walton (*American Naturalist*, Vol. XL., 1906, p. 705) says:

> The absence of any tentacular process in *Naidium osborni* suggests that until a species is found in which the process is well developed and in which the dorsal bundles contain biuncinate setæ, the genera may be considered distinct.

Walton prophesies the finding of such a species, and apparently suggests the inference that when such a species is found the genera need no longer be considered distinct. This species has been found and will be more fully described in a later paper on the Naididæ. It was found at the University of Virginia in the spring of 1909, in an aquarium stocked from a small pond in the neighborhood. It differs from *Pristina breviseta* of India only in length, being considerably shorter, not exceeding 8 microns in length, but is otherwise identical and it seems best not to establish a separate species to receive it. In the American forms of this species the tentacular process varies greatly in length. In one individual it was not developed at all, in others it was developed to a length of several microns, and intermediate lengths are numerous. There are always, however, the bifid needle-like setæ in the dorsal bundles. But if we are to make this a generic character, why not make the presence of serrations on the capilliform setæ a generic character? And while we set off those forms with the bifid setæ in the dorsal bundles and no well-developed tentacular process, what shall we do with *Pristina dadeyi*, which has neither tentacular process nor bifid dorsal setæ? Michælsen's recombination of the two genera, therefore, is confirmed by the finding of this form, and it is correct to include under the head of *Pristina* all the species hitherto described under the heads of *Pristina* and *Naidium*, whether the prostomium be tentacular or not, whether the capilliform dorsal setæ be serrated or not, and whether the dorsal bundle contain a bifid needle-like seta or not. These characters are found in parts which vary greatly and the great resemblances among the various species in the position of the setæ and of the internal organs are more important.

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CONCURRENT INFECTION BY FIVE SPECIES OF INTESTINAL WORMS, INCLUDING SCHISTOSOMA MANSONI

INSTANCES of the presence of two or more species of parasitic worms in one person are common and many such are on record. To cite some of the more recent literature, Garrison and Stiles, '06, in an examination of 3,457 persons, found that thirty-five harbored two species of intestinal parasites and that one was infected with three species. The Porto Rico Anemia Commission, in the course of its very extended studies, found frequent instances of double infection, not rarely triple infection, and, in two cases, determined the presence of four distinct species. Piraja de Silva, '09, working in Bahia, Brazil, reports several similar cases of quadruple infection. A case which has recently come to my attention is of interest not only as an extreme case of concurrent infection but as one of the few known instances of the occurrence of the blood-fluke, *Schistosoma mansoni*, in the United States.

On May 3, a local physician sent to me, with the request that I make a blood examination, a Porto Rican who exhibited obscure symptoms suggestive of filarial infection.

The patient, who was a young man twenty-five years of age, had been in this country for five years, except for three brief visits home. The fresh blood was carefully examined and smears to be stained were made, but on account of the well-known periodicity in the appearance of filariæ in the peripheral circulation, the patient was requested to return at night.

In the meantime, the blood smears were stained with the Nocht-Jenner-Hastings stain and examined for possible malarial parasites. None were found, but there was a marked eosinophilia (20 per cent.), such as is often due to infection by parasitic worms.

When the patient returned, a search for blood filariæ was made, with negative results. On account of the eosinophilia, a sample of the feces was then examined microscopically. In this were soon found the large, characteristic eggs of *Schistosoma,* a very few of *Ascaris lumbricoides,* and many larvæ of *Strongyloides stercoralis,* the Cochin China diarrhea worm.

When the result of the examination was reported to the physician in charge of the case, the usual treatment with purgatives and anthelminthics was adopted. Unfortunately, the patient made no effort to save the specimens dislodged, except that a sample, taken some hours after the treatment, was sent me. In this sample the three species above mentioned were present, the number of larvæ of *Strongyloides stercoralis* being much larger than in the first sample. In addition, there were found a small number of the eggs of the hookworm, *Necator americanus,* and of the whipworm, *Trichuris trichiura.* I afterwards learned that following the medical treatment, a full-sized *Ascaris* had been voided.

Thus this patient harbored five distinct species of parasitic worms, differing from the two cases reported by the Porto Rico Anemia Commission by the presence of the larvæ of *Strongyloides stercoralis.* Excepting those of *Schistosoma,* the eggs of the various parasites were but few in number.

The many eggs of *Schistosoma* were *all* lateral-spined. In view of the discussion as to whether this type of eggs is from a species distinct from *Schistosoma hæmatobium,* a careful examination of the urine was made. No eggs or traces of them were found, although it is here that the typical, terminal-spined eggs of *Schistosoma hæmatobium* are most readily demonstrated. Neither was there any history of bloody urine, or evidence of blood corpuscles in the fluid—symptoms commonly associated with the presence of the ova of *Schistosoma hæmatobium* in the urinogenital system. This is in agreement with the evidence recently brought forward by Sambon, Holcomb and others to show that the West Indian and South American schistosomiasis is due to a distinct species, which also sometimes occurs in association with the better-known species in Africa. To this species with lateral-spined eggs, Sambon, '07, gives the name *Schistosoma mansoni.*

The few records of the occurrence of *Schistosoma* in the United States are all, like the above, of imported cases. Most of them are recorded from transient visitors, or from soldiers returning from South Africa, and refer to infection by *Schistosoma hæmatobium,* terminal-spined eggs having been found in the urine. Wm. A. Riley

SOCIETIES AND ACADEMIES

THE ELISHA MITCHELL SCIENTIFIC SOCIETY

The 29th annual meeting of the society was held on September 27 in Chemistry Hall, University of North Carolina, with the president, Dr. W. B. MacNider in the chair. The following officers were elected:

President—Dr. E. V. Howell.
Vice-president—Professor P. H. Daggett.
Permanent Secretary—Dr. F. P. Venable.
Recording Secretary—Dr. J. M. Bell.
Editorial Committee—Dr. W. C. Coker, Professor A. H. Patterson, Dr. J. M. Bell.

The following new members were elected: Dr. W. H. Brown, Messrs. T. R. Eagles, J. W. Lasley, J. G. Beard, A. M. Atkinson, C. S. Venable, J. E. Smith, W. C. George.

James M. Bell,
Recording Secretary

Chapel Hill, N. C.